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THE ELECTRICAL TREATMENT OF SEWAGE—THE WEBSTER PROCESS.

On Wednesday, March 27th, we went down to Crossness, in company with a number of representatives of the scientific and technical press, to see this process in operation on what may be called a practical scale—12,000 gallons per hour. We had heard rumours that a novel and highly improved dynamo had been brought into operation. No such claim, however, was made by the patentee, and the machine actually in work is an Edison-Hopkinson, capable of developing an energy of 43 horse-power, and actusted by a pair of engines, each of 20 nominal horse-power. The electrodes are plates of cast iron, over which the sewage travels along a series of shoots and is then received into settling tanks. The action is very rapid; a dull, greenish-gray sediment is formed and rises to the surface, being buoyed up by multitudes of bubbles of hydrogen gas. When these bubbles escape the deposit sinks to the bottom, and the clear supernatant water may be drawn off and allowed to flow away. The reality and completeness of the action was shown by glasses of the liquid dipped up for inspection, and, to make the process more intelligible, portions of the sewage—ordinary London sewage—were placed in glass jars and treated by immersing in each a pair of iron electrodes connected with a portable battery. These experiments were shown with recent sewage, with stale sewage, with waste dye liquors, &c., and in every case clarification and purification were rapidly effected. The complete settlement of the deposit on the large scale takes place in from one to two hours.

The *rationale* of the process seems to be this: a portion of the iron—about 2 grs. per gallon of the sewage subject to electrolysis—is dissolved by the hypochlorous acid generated by the decomposition of the common salt present in the sewage. This hypochlorite of iron combines with and precipitates the suspended impurities and a portion of the dissolved organic matter. On this latter point Mr. Webster speaks rather undecidedly. He says that the organic matter in solution is oxidised "by means of free nascent chlorine and oxygen given off at the positive plate." This will undoubtely happen. But he goes on to say that when sewage is treated with solutions of chemicals "the resulting effluent requires further treatment with some oxidising agent to remove the organic matter in solution." This is not necessarily the case. There are methods which remove as much as three-fourths of the dissolved organic matters, leaving chiefly substances which are not readily oxidisable, and present no danger to public health.

In the analysis of the water after being submitted to his process the "albumenoid matter" ("albumenoid ammonia" of Wanklyn, organic nitrogen of Frankland), generally considered the most dangerous impurity, is reduced in the three cases respectively given from 0·6 per 100,000 to 0·28, from 0·54 to 0·24, and from 0·5 to 0·2. These results are good, but we must not be considered captious if we remark that better results have been reached by the ordinary chemical processes. Very probably the electric treatment of sewage is capable of further development.

The strong point of Mr. Webster's process is its apparent cheapness. If we did not misunderstand the patentee, one million gallons of sewage can be treated for the sum of 13s. At this rate the sewage of London would cost for mechanical and electrical power, labour and fuel, £40,000 yearly. We must, however, add that this calculation does not appear to include interest on first cost and the repayment of loans for construction. And it admittedly does not include the cost of dealing with the precipitate, or what is now commonly called sludge. On this very important part of the sewage question Mr. Webster has ideas, but they have not reached any definite shape, and they certainly do not form part and parcel of his patent. Those who have had experience in sewage treatment will feel disposed to add to the £40,000 no small percentage under this head.

Mr. Webster's process finds here, as compared with other sewage schemes, both an advantage and a difficulty. The total weight of deposit will be less than in any chemical process, because he adds to the sewage no ponderable matter, save the two grains of metallic iron per gallon of sewage treated.

On the other hand, the patentee considers that his deposit will have *less* fertilising value than farm-yard manure, a point not to be wondered at if we consider that the dissolved impurities are to be destroyed by the nascent oxygen and chlorine instead of being precipitated.

Now there are sewage manures which, without any extraneous addition contain nitrogenous matter equal to 3 per cent. ammonia and tricalcic phosphate 5 per cent.—a composition much superior to farm-yard manure.

A strong point in favour of Mr. Webster's process is that neither the deposit nor the effluent water will be limey.

THE electrolytic action between iron and lead, about which Prof. Forbes has alarmed himself unnecessarily, may have been noticed by himself time after time without his attention having been directed particularly to it. It has been a frequent practice for many years past to secure railings in stonework by the use of lead. In such places, where the rain runs down the iron the action is found at the junction with the lead, and at once commences, its rapid continuance being hastened by the washing effect of the rain. Railings reduced from the original size to various thicknesses by this cause, may be seen in walks taken in any part of London.

THERE is one remarkable fact in connection with the decay of the lead covering of cables which does not seem to have been noticed. Attention has been drawn to the many failures and also examples have been shown of the durability of many others, but whereas the manufacture of the latter is distinctly old, or of the old form, that of the former is unquestionably modern. It comes to this then, that the samples of cable showing durability are as manufactured in the early days of telegraphy, or on similar plans, whilst those which have lately failed have been of the very latest and improved (?) form. In other words, the successful lead-encased cables are those which were formed of a regularly made cable drawn into a properly formed leaden tube, which was then closely pressed round it. In the latest or improved form, the lead is in a molten state formed round the cable as it passes through the press, and a covering of an external diameter, regulated by the size of the die, is the result.

IN the properly formed leaden tube as formerly used the thickness of the lead is uniform throughout, and no undue heat is employed in the pressing of the lead to form the pipe, but in the later form where the lead is pressed round the cable, which becomes practically a mandril, the heat is very great, and owing to air space and other causes there is no certainty of the thickness of the lead being uniform. Given a lumpy place in the cable, a bend, or any undue thickness (which cannot always be prevented) there is of necessity a difference in the thickness of covering. Cables covered by the latest processes should, to secure a proper and safe thickness of lead casing, have a duplicate covering.

THE ill wind which left the town of Halifax in darkness on more than one occasion lately is likely to blow the electric lighting companies some good. The Corporation has recently had trouble with its workmen at the gas-works. The men endeavoured to assert themselves by stopping the manufacture of gas, and the inconvenience which arose was so great that the electric lighting companies put forward applications to cross streets with overhead wires, and supply light from an independent source. As a result of applications made to the Town Council, a special committee has been appointed to consider the matter, and has recommended the Council to give consent for the carrying of wires, &c., over the public streets, subject to certain conditions. A public company is being formed for supplying electric light, but it is not stated that the Town Council is recommended to favour one or any system exclusively. In the meantime the Schmidt-Douglas Company, Blakey, Emmott & Co., and Messrs. Luther Hanson & Co. are busy running wires, and lamps are now hung in front of many of the shops in Crown Street, Commercial Street, Corn Market, and Northgate. There is no doubt that the possibility of the town being left in total darkness is thus being done away with, but it is not so clear that in the day-time the appearance of the town will be improved by the overhead cables which the competing companies are erecting in all directions in the most irregular fashion.

IF some guiding hand is not soon stretched out to the Electrical Trades Section of the London Chamber of Commerce it will find itself within such a maze of confusion that it will become a task of considerable difficulty to emerge therefrom and light upon the right path again. A sectional meeting took place on Thursday afternoon of last week, and the transactions were of such a nature as to lead us to the above expressed conclusion. It appears that nearly every subject under consideration must have its committee, and as the section has been described as the most energetic and hard working in the whole Chamber, it can readily be imagined that the points for discussion are numerous. There are already committeemen who complain that they are completely befogged between one matter and another; neither the chairman nor members of one committee, at least, which had been considering the subject of Overhead *v.* Underground Wires, appeared to have the slightest idea of the result of communications made to the Board of Trade; and in one instance it appears that the Electrical Trades and Engineering Sections had become completely mixed.

THE very notice convening the gathering seemed to several of the gentlemen present somewhat indefinite. At the commencement of business the lengthy minutes of a previous committee meeting were read, when someone asked whether the members present were attending a general committee or a meeting representative of the trade. Nearly three quarters of an hour were wasted in discussing the real object of coming together; some slight mutual recriminations were indulged in, and several gentlemen were on the point of withdrawing altogether, when it was resolved that the assembly was a trade meeting, and that the prior proceedings were both irregular and out of order.

THE first point for consideration was the selection of seven delegates to meet the Standardising Committee of the Institution of Electrical Engineers. After a deal of discussion the names were selected and sanctioned. Thereupon the whole matter was reopened on the ground that as all the science necessary could be found in the Institution of Electrical Engineers, the gentlemen just elected did not sufficiently represent the commercial element. Another ballot was then taken, with the result that a fresh set of delegates was appointed, to whom it must have been a great surprise to learn that they must be prepared to meet their colleagues on the following afternoon, so well prepared must they have been to argue calmly and dispassionately upon such a topic as that of standardising electrical apparatus.

THE proposed formation of a vigilance committee which should seek for information useful to the section in its dealings with the Board of Trade, local authorities, and other bodies, brought Mr. Musgrave Heaphy upon his feet. This gentleman gave the meeting clearly to understand that nobody would be permitted to poke his nose into anything relating to the "rules and regulations" over which he exercises supreme control, and the proposition was, in consequence, in momentary danger of collapsing altogether. Such a mishap was, however, averted by the presence of mind of Mr. Garcke, who, parodying the style of Mr. Heaphy in an allusion to the company which he represented, happily enabled the meeting to regain its equanimity.

IT is a subject for regret that these open meetings are not more numerously attended by the members of the section, for the number present did not equal that of the general committee, of which the assemblage appeared to be mainly composed. The Chairman has far too much to take up his attention in other directions; the worthy Secretary of the Chamber must find it difficult to keep himself *au fait* with the business of the electrical trades section, and, in point of fact, it will assuredly become necessary very shortly to institute some different methods of procedure to those at present in vogue. This, we think, will be candidly admitted by all who were present at the meeting which led to these comments, and the suggestion of Major Flood Page that a secretary to the section, subject to Mr. Kenric Murray's authority in all matters, should be appointed to steer the electrical trades clear of the breakers upon which they now seem drifting, is altogether worthy of hearty support.

IT is said that the Edison-Swan Company is likely to figure in another lawsuit with the makers of the "Sunbeam" incandescent lamp. This latter is, as our readers are aware, used at high candle-power, and the filament must therefore be somewhat thick compared with the ordinary form of incandescent lamp carbons.

THE United Telephone Company has, we understand, also commenced the preliminaries to a fight; namely, applying for an injunction (application postponed for a few days) to restrain the New Telephone Company from infringing its patents. Oh! Happy lawyers.

ACCORDING to a correspondent who has recently penetrated to the little known and barely accessible town of Seoul, the capital of Korea, the electric light has been set up in the King's Palace. It is true he speaks of the fittings as "gim-crack;" but that the light should have spread to such an outlandish place, where King and nobles and people generally appear to be half-savages, is surprising enough.

"MR. LANGDON-DAVIES is to be congratulated upon having made a most momentous discovery which seems to be destined to revolutionise electric telegraphy, and to economise cost in telegraph systems to an enormous extent. That it will promptly be adopted not only in this country but all over the world, cannot for a moment be doubtful, and its possibilities are so far-reaching that they cannot as yet be fully realised." With this charming specimen of stereotyped claptrap a contemporary terminates an article on Mr. Langdon-Davies' "Phonopore." The invention bears a most remarkable resemblance to the Phonoplex or Wayside Duplex of Edison, brought out a few years ago. Originally the Phonopore was a telephonic system worked in conjunction with an ordinary telegraphic circuit; it was said to have been remarkably successful between London and Folkestone and its value was, at the time it was brought out, heralded in much the same terms as those we have quoted; we hear nothing of it now, however, which is significant.

THE *Révue Internationale de l'Electricité* states that Mr. Edison has recently patented an entirely new system of electrical distribution. The *modus operandi* appears to be one well known on this side for many years past, and consists in periodically interrupting the flow of the current, so that it is only in circuit with the mains intermittently, and if the interruptions follow each other with sufficient rapidity a perfectly steady light is obtained. In reducing this principle to practice it is proposed to take the current with high tension mains to one or more points in the district to be lighted, and to establish there secondary distributing centres, in each of which the main current will be split up into two or more lamp circuits by means of a current controller. This controller consists of a shaft rapidly rotated by an electromotor in the main circuit, and which is fitted with brushes, through which the current is laid from the high tension mains to the two or more lamp circuits proceeding from the station. These brushes are arranged so that only one of these latter are in circuit with the main at any one instant, each lamp circuit being connected up with the main in turn as the shaft of the controller revolves. There were, we believe, quite a number of patents taken out some 10 years ago for supplying current to electric lamps by means of a revolving brush passing very rapidly over contact bars, each of which was connected to its own separate circuit. Perhaps, however, we have misunderstood the nature of Mr. Edison's reported new invention.

THE Fritsche dynamo, which we believe was for the first time in England illustrated in the REVIEW for January 18th, 1889, has another claimant for the honour of its invention, M. Desroziers, of Paris, being the individual who thinks that he has antedated Mr. Fritsche's device. Mr. F. M. Weymouth, writing to *Industries* on this type of machine, does not anticipate that it will, although ingenious and original, beat every other dynamo out of the market; indeed he criticises both Fritsche and Desroziers rather unmercifully in a lengthy communication which is well worth perusing.

A SYNTHETIC STUDY OF DYNAMO MACHINES.

(*Continued from page* 293.)

VI.—ARMATURES IN PRACTICE—(*continued*).

20. *Armatures with Iron Cores.*—In our last article we considered the E.M.F. generated in the Mordey, Ferranti and Siemens machines, these being typical of alternators without iron in their armatures. Several continuous current dynamos, with coreless armatures, were designed years ago, but these have disappeared one by one from the scene of practical work. Quite recently a universal resurrection of such machines seems to have taken place, but it is not proposed to say anything of their merits or demerits here, since the several designs have not been sufficiently long in use to afford reliable evidence of their electrical or mechanical efficiency. Leaving these continuous current armatures for future description, we pass on then to the consideration of armatures with iron cores.

We shall continue to speak of the armatures belonging to machines of *Class 1*, dealing with those of *Classes 2 and 3* later on. The former are of a more simple character, considered in their relation to the external part of the circuit, since the armature conductors are directly connected to the mains without the intervention of a commutator, being coupled to the terminals of the coils themselves in the case of a stationary armature, or to contact blocks pressing on rings terminating the coils if the armature rotates.

We have in a previous article stated distinctly the function of the iron core in an armature, which is of a two-fold character. Its use is first to reduce the magnetising force to a minimum by filling up with iron as much of the magnetic circuit as possible, and secondly, to give the lines of force the direction we wish them to have by guiding them right through the coils. The armature core is a part of the magnetic circuit of the machine, and in our calculations for the magnetic induction, we have in each case considered the magnetising force required for the induction through that part of the circuit. Generally speaking, the machines which have iron cores in their armatures would not work at all without them. Besides reducing the magnetic induction to a fraction of its present value, taking away the core would, in the case of the armatures described in this article, cause all the lines induced to pass between the adjacent magnet limbs without going through the armature coils at all. Hence none of the alternating current machines here referred to could possibly work with a coreless armature.

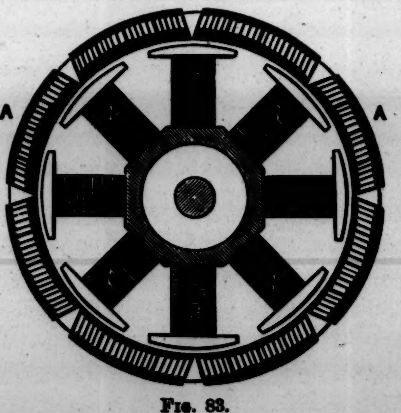

FIG. 83.

Claiming our first attention, as the parent of several present day machines, is the alternator of Gramme, which made its appearance ten years ago. It is illustrated diagrammatically in fig 83, and consisted of a stationary ring armature, A, A, within which rotated eight field magnets, N, S, &c., arranged radially as shown, and of alternate polarity. The armature core was a cylinder 32 centimetres long, having external and internal diameters of 49·9 and 45·9 centimetres respectively. This was built up of soft iron wire, wound round and round circumferentially, being when finished insulated with tape, and wound with coils of insulated wire in sections, as shown. The machine was specially designed for supplying current to Jablochkoff candles, and the armature coils were grouped so as to furnish successively currents to four separate circuits. This machine, which has now but a historical value, has formed the model for several machines designed since.

A modification of the Gramme alternator, in which the ring armature is caused to rotate while the magnets are arranged radially on the outside of it, was shown in fig. 62 (page 694, Vol. XXIII.). Here there are twelve magnets of alternate polarity attached to an outside yoke ring, and the armature core may be built up of iron wire or of thin charcoal iron washers, separated each from its neighbour by paper. There must be wound on the armature twelve coils to correspond with the twelve field magnets, and as the direction of the induced E.M.F. is opposite in adjacent coils, it follows that to add their effects they must be coupled as shown in fig. 84, where N, S, N, S, are magnets of north and south polarity alternately, and A, B, C and D are armature coils. In fig. 85 are shown to scale the magnets, N_1, S_1, N_2, S_2, part of the yoke ring, C, D, part of the armature core, A, B, and one of the armature coils of a machine of this type recently constructed. The width of each magnet is in this machine equal to half the pitch, while the width of the armature coils is four-fifths of the pitch. The distribution of the field may be assumed as represented by the dotted lines, and it will be seen that the width of the area through which the lines enter the armature is by no means confined to the width of the poles. Quite apart from the fact that there is a considerable waste field passing between adjacent limbs, there is a certain spreading out of the lines where they enter the armature. As previously stated, this extension of the field has been fixed by the Hopkinsons at ·8 of the space between the magnets and the core, consequently in the case of magnets of small width it constitutes a rather large fraction of the width of the magnet. Taking the coil, fig. 85, in the position shown —the position where the induction is reversed—we see that all its convolutions do not enclose the same number of lines of force. A convolution on the line *c*, *d*, encloses all the lines passing into the core, but convolutions at *a* and *b*, do not enclose nearly so many. As a consequence, all the convolutions have not the same value as regards adding to the E.M.F., and a calculation based on the assumption that each convolution is equally effective would show too high a value. By plotting out the probable distribution in much the same way as shown in fig. 85, we can derive a coefficient which, multiplied by

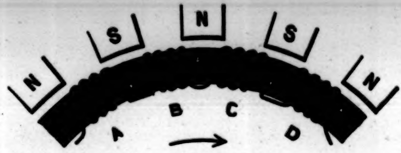

FIG. 84.

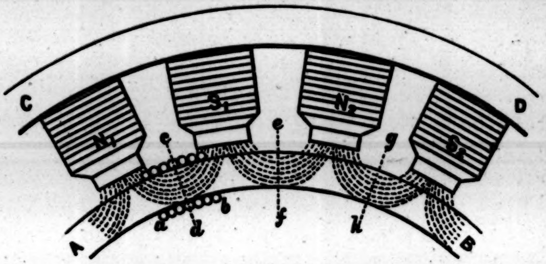

FIG. 85.

the total number of lines passing through the core, gives a number which might be considered as the equivalent of the lines passing through every convolution of the coil.

In a machine of this character we can obviously wind the wire over the whole of the armature surface, over four-fifths as in the particular machine referred to, or over a less amount, say half the surface, as is done in several cases. To get an idea of the difference produced by widening the coils, consider the E.M.F. generated in the coil consisting of two convolutions, fig. 89, which moves in the direction of the arrow.

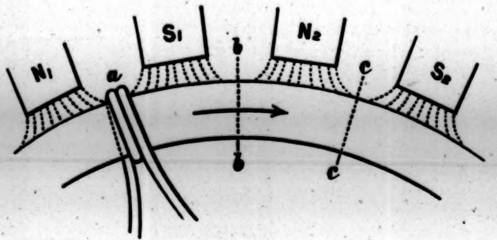

FIG. 89.

Just in the position shown, no lines of force are being cut and the E.M.F. is *nil*. It is the position of reversal. As it moves from the position shown an E.M.F is induced, and from a, to b, all the lines proceeding from S_1 are cut by the two convolutions. There is now a reversal, and from b to c an E.M.F. is induced in the opposite direction by the cutting of the lines proceeding from N_2, the cycle when c is reached being complete. If N is the number of lines entering the armature from each pole, each convolution during a cycle cuts $2N$ lines, and s being the number of revolutions per second, c the number of convolutions, and p the number of poles, the average E.M.F. is

$$E_{\text{average}} = \frac{N p s c}{10^8}.$$

Now suppose we add two more convolutions, so that the space occupied by the four is equal to the pitch, as in fig. 90, what will be the effect as regards E.M.F.? We are only considering that part of the convolution on the outside of the core which cuts the lines, so it does not matter how the wires go inside the core and at the ends. The widened coil is shown in the position of reversal, as in the preceding figure. On moving in the direction of the arrow E.M.Fs. will be induced in the two outside convolutions, but since one cuts lines from N_1 at the same rate as the other does lines from S_1 they will be in opposite directions and of equal value, the effect of these two convolutions therefore in adding to the E.M.F. of the coil being *nil*. If the coils then are wound of width equal to the pitch, the outside convolutions contribute nothing to the E.M.F., and those, two or three convolutions inwards may contribute very little. On this account the coils are wound of less width than the pitch, but it will be seen that our expression for the E.M.F. in which all the convolutions are supposed to have the same values requires some modification.

We have stated in a previous article that the E.M.F. generated may be treated as the sum of the inductions in the individual elements of the coil due to cutting lines of force or as caused by an increase or diminution per second in the number of lines enclosed by the coil. In the machine under treatment it may be convenient to consider the E.M.F. from the latter point of view. Take the coil in fig. 89. In position, a, the lines enclosed are $\frac{N}{2}$. In moving to a position opposite S_1 these are all subtracted. In moving to b an equal number is added, and so we have N lines for the half cycle, or $2N$ for a cycle, the same as when we considered the question in the other way. Observe that the lines enclosed are maximum when the E.M.F. is nought, and that the E.M.F. is a maximum when the lines are nought. The outside convolutions in fig. 90 are shown to induce no E.M.F., because when the coil is moved there is sent through one convolution as many lines from N_1 as there are sent in the same direction through the other convolution lines from S_1, their number considered with reference to their direction, and sign being nought. Whatever be the width of the coil, the number of lines passing through all its convolutions, when it is immediately opposite a pole considered with relation to the direction of the lines, is nought, and it follows therefore that the E.M.F. generated is proportional to the number of lines passing through each convolution at the position of reversal. By mapping out the probable distribution of the field we can see what width to make our coils. If equal to the pitch, the outside convolutions, when the coil is in the position of reversal, enclose no lines, therefore they contribute no E.M.F. The centre convolutions enclose all the lines, therefore they contribute a maximum E.M.F. Intermediate convolutions contribute according to the lines enclosed, but owing to their not all having the same activity we have to multiply by a coefficient which depends upon the width of the coil and the distribution of the field. This coefficient may be said to reduce N to a value which may be assumed as the effective number of lines if all the convolutions are equally active, or to reduce c to a number which may be considered as the effective number of convolutions for the full value of N.

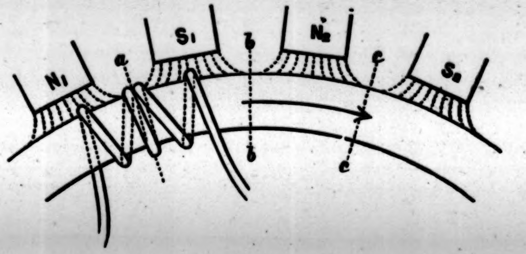

FIG. 90.

(To be continued.)

ON THE USE OF LISSAJOUS'S FIGURES TO DETERMINE A RATE OF ROTATION, AND OF A MORSE RECEIVER TO MEASURE THE PERIODIC TIME OF A REED OR TUNING FORK.

By Prof. J. VIRIAMU JONES, M.A.*

IT is sometimes of importance to determine with great accuracy the angular velocity of a rotating body at a given instant. For instance, in measuring an electrical resistance in absolute measure by the British Association method or the method of Lorenz, the rate of rotation of the revolving coil or disc must be known with full accuracy at the time when the reading of a galvanometer needle is taken.

The method I have to bring before the Physical Society in this note consists in obtaining, by means of Lissajous's figures, equality of period between the rotating body and a reed maintained in vibration electrically, and then subsequently determining the vibration period of the reed.

1. *The use of Lissajous's Figures to obtain Equality of Period between the Revolving Apparatus and the Reed.*

In one end of the axle of the revolving apparatus (which in the application of this method in the laboratory of the University College, Cardiff, is a Lorenz disc rotating about a horizontal axis) a pin is placed excentrically. The pin fits accurately in a hole in a rod free at one end, and constrained to move only longitudinally at the other. Fig. 1 represents an end view of the axle, M, M, M. The excentric pin is indicated by the dotted circle at B. The pin fits into a hole in the rod, S, S, free at the end, C, the other end, A, being constrained to move only longitudinally.

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* Communicated to the Physical Society on March 23rd, 1889.

When the apparatus is in rotation the excentric pin impresses on the rod a vibratory motion, and the vibration period of the rod is equal to the revolution period of the revolving disc.

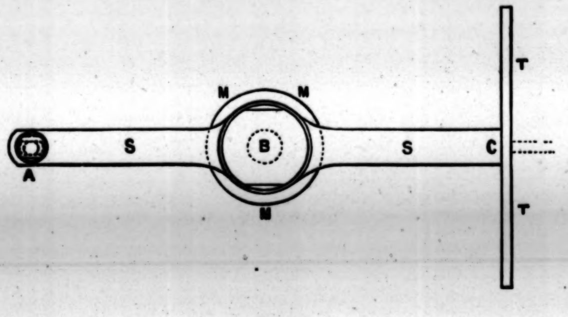

FIG. 1.

To the free end of the rod a mirror, T, is attached. In the apparatus in my laboratory, already mentioned, the axle is horizontal and the rod moves in a vertical plane.

The reed is a steel bar 100 centim. long and its section is rectangular., 1·51 centim. by ·60 centim. It is clamped in a massive iron frame, and by moving the bar in the frame the vibrating segment may be made longer or shorter, so as to vary its vibration period. The period may be further adjusted by the movement of a rider.

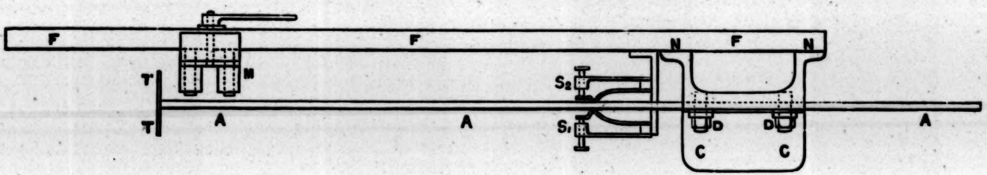

FIG. 2

Fig. 2 is a plan of the reed and its electrical arrangements, which are a little different from those in ordinary use, in order to allow, without inconvenient re-adjustment of the springs, the lengthening or shortening of the vibrating segment. A, A, A, is the steel bar. C, C, the iron frame to which it is clamped by the bolts and nuts, D, D. This stand is clamped to a large wooden block resting on a concrete floor. F, F, F, is a wooden piece attached at N, N, to the iron frame, and bearing the electro-magnet, M.

On the opposite side of the vibrating bar to the electro-magnet there is a pair of springs, S_1. One of the pair is always in contact with the bar as it vibrates, and the other fitted with screw adjustment, makes and breaks contact with the first. The first spring is connected through the electro-magnet with the pole of a suitable battery, the other pole being connected with the second spring. The apparatus gives no trouble, and once started the reed will vibrate for hours without attention.

To the free end of the vibrating segment a mirror, T, T, is attached. In my apparatus the reed moves in a horizontal plane, and so that its plane is at right angles to that of the vibrating rod attached to the axle of the rotating disc. Therefore, the image of a spot of light seen by reflection in both mirrors (viz., that attached to the rod on the axle, and that attached to the reed) will for synchronism be drawn out into some form of ellipse, and the permanence of the ellipse is an exact test of equality between the vibration period of the reed and the period of revolution of the rotating apparatus.

2. *Determination of the Vibration Period of the Reed by a Morse Receiver.*

Opposite the pair of springs, S_1, connected with the electro-magnet, M, and concerned with the maintenance of the reed in vibration, there is another pair of springs, S_2, similar in every respect. One of these is connected through a Morse receiver with a battery of the requisite electromotive force, the other being connected with the other pole of the battery. When the reed is in vibration it makes and breaks contact between this pair of springs, and we have, therefore, on the tape of the Morse instrument a series of dashes, a dash and the blank space between it and the next corresponding to one vibration of the reed.

On the same tape, side by side with the track of the inking wheel of the Morse instrument, a pen is made to record the movement of the pendulum of the standard clock in a sufficiently ordinary manner. We have, then, merely to count the number of dashes in a given time, and we have the number of vibrations in that interval, and hence the pitch of the reed.

The electrical connection is made in my laboratory by the escapement wheel of the clock; and hence for accurate result the time taken must be an integral multiple of a minute, the period of revolution of the wheel.

This method of determining the vibration period of a reed, or tuning fork, has seemed to me to be of extreme simplicity, and by taking a sufficient interval of time may be made of any desired accuracy. A Morse receiver will spin out its tape at a speed of 40 feet a minute, and the ordinary rolls of tape will last for at least 15 minutes when it is doing so.

The limit of accuracy in this method of determining the rate of rotation is, I find at present, the constancy of vibration of the reed. It has been a surprise to me to find that the reed is not constant, arranged as at present, to more than one part in 1,000.

In conclusion, I desire to express my thanks to Mr. John Gavey, of the South Wales Postal Telegraphic Department, for the help he has rendered me in connection with this matter.

University College, Cardiff,
March 22nd, 1889.

DISCUSSION.

Prof. AYRTON, whilst recognising the extreme importance of determining speed accurately, suggested that the inconstancy of the reed may be due to the impulses being given at the end instead of at the middle of its swing, and recalled an experiment shown before the society by Prof. Perry and himself, in which the pitch of an electrically driven fork was varied greatly by altering the adjustment of the contact screw. Referring to Dr. Thompson's modification where two tuning forks drive each other, it was pointed out that the method requires the synchronism of the two forks to be very exact.

Mr. BLAIKLEY enquired whether any doors were opened or closed during the experiments, as the pitch of a reed is affected by the size of its resonance chamber. He also stated that the pitch of reeds driven pneumatically could be maintained constant to one part in 10,000, and mentioned that two forks nearly in unison influence each other's period when near together.

Referring to the two forks mentioned by Prof. Ayrton, Prof. S. P. THOMPSON said it was advantageous to mount such forks on sounding boxes, for when placed at a suitable distance apart they then exert considerable mutual control. The sketch put on the board by Prof. Jones led Dr. Thompson to suppose that a perfect method of driving forks had been devised, for two springs were shown touching opposite sides of the bar, and such an arrangement might be used to complete the circuit, only when the reed is in the middle position. He also believed that forks gave greater consistency than single reeds, and mentioned some recent improvements in which one prong of an electrically driven fork is made of phosphor bronze.

Mr. T. H. BLAKESLEY, reasoning from ideas suggested by Mr. Stroh's experiments on vibrating membranes, concluded that the periods of forks placed at one-quarter wave length apart would not uninfluence each other.

In reply to a question from Mr. F. J. Smith, Prof. JONES thought there could be no "creeping" of the reed through the clamp. He also stated that he had been led to use a reed from the results obtained in Delany's system of telegraphy, and the fact that Lord Rayleigh considered electrically driven forks satisfactory.

ELECTRICAL DISTRIBUTION IN BRUSSELS.

THE Conseil Communal of the town of Brussels has adopted the following programme with reference to the organisation of a service of electrical distribution in that city :—The town of Brussels will receive up to the 1st of July next plans for the establishment and the carrying on of a system of electrical distribution by underground wires for electric lighting and the transmission of power purposes.

The contractors must submit plans of a nature to assure, as a first installation, a service of not less than 10,000 lamps of 16 candle-power in an area indicated by the plan.

They must state distinctly the conditions under which they engage (on the demand of the town) to extend this lighting beyond the stated area. The concession will be for a maximum of eighteen years, the town reserving to itself the right of terminating all the installations after three, six, or nine years, and after the expiration of the concession the contractors must indicate the conditions of withdrawal after each of these terms. They must indicate, also, the price which they will demand per 100 watt-hours for providing the current :—

1. To individuals.
2. For the public lighting and for the services of the town.

They must state the rent which they offer to pay to the town, and the security which they will give in order to assure the execution of their obligations.

The applicants for the concession must present a specification of the charges, stating exactly all the conditions under which they accept the undertaking. The two following clauses must be inserted in it :—

The delegates of the town may from time to time have access to the establishments of the concessionaire in order to control the account service.

The contractor will have his concession terminated if it is shown that the working is not equal to the exigencies of a good service. This will be verified by three experts, nominated, one by the town, a second by the contractor, and a third by the President of the Tribunal in the first instance.

EXTENSIVE ELECTRIC LIGHTING IN ST. LOUIS.

THE city of St. Louis has lately been the scene of active competition for the new electric lighting to be done there, and the awards by the special committee of the Board of Public Improvements have just been announced. We quote the following from the St. Louis *Republic*, which after stating that Mr. Charles Sutter will put in an Indianapolis Jenney plant under his contract says :—

"The plant is to be one of the largest ever constructed in the world, and will cost at the lowest estimate $750,000. The ground has already been secured in a central portion of the city, and on the line of one of our large railways. This will give them every facility for handling their material without the necessity of draying it. The item of coal alone is a large one when the fact is considered that the consumption of that commodity will aggregate 100 tons per day, or 36,500 tons per year. The construction will give employment for eight months to 1,000 men in various capacities, and when the actual work of lighting begins 250 men will find steady work.

"The Indianapolis Jenney Company and the New York Electrical Accumulator Company, whose respective systems will be brought into use, have already increased their capacities, and are now in a position to go to work immediately.

"The plant will be capable of maintaining 4,000 arc lights of 2,000 C.P. each, and 10,000 incandescent burners of the accumulator system. Of the 4,000 arc lights 2,226 will be used for lighting the streets, as stipulated in the contract, and 1,774 for private use in commercial buildings and elsewhere. Of the 10,000 incandescent lights more than 4,000 have already been disposed of, and the company say that they can give a light greatly superior to gas and at an equal cost, still realising a handsome profit. In the construction of their lines over 300 miles of wire will be used, and negotiations are now pending to supply it. Twenty miles of this will be placed in underground conduits and the remainder strung upon poles. The arc lights will consume 3,000,000 carbons a year, which, at a cost of $10 per 1,000, will reach a cost of $30,000. Their revenues from their contract with the city will be $166,439.50 a year, which, together with their receipts from private lighting, will bring them in about $300,000, from which they expect to realise a handsome profit.

"The whole enterprise will be under the superintendence of Mr. D. J. Harris, who is now consulting engineer and manager of the Accumulator Company. He has had an experience of 17 years as an electrician, during which time he has, at different periods, been in the employ of the Governments of France, England, Germany and Italy. Among other things Mr. Harris is now completing arrangements for a universal electrical exhibition, to be held at the Exposition Hall in this city, commencing September 4th of the present year, which will continue for a period of six weeks. The announcement has been made that no charge shall be made either for power required or space occupied to exhibitors whose application shall have been received prior to April 15th."

We may add that the awards were : to Mr. Sutter for arc lighting, $84,780.50 and $81,659 ; to the Missouri Electric Light and Power Company (Westinghouse) for incandescent lighting, $50,525 ; to C. A. Brown (Western Electric) for incandescent lighting, $33,327.80.

DEATH CURRENT EXPERIMENTS.

THE New York State authorities have been making experiments in administering electric currents to produce death. According to the *Electrical World*, the object of these experiments, which were made on March 12th, was to determine the best points of application, duration of contact, and electromotive force of the alternating current, for executing condemned criminals by electricity. Current was derived from a Siemens alternating current dynamo, whose field was separately excited ; a rheostat was provided for varying the electromotive force from 100 to 1,000 volts. A Cardew voltmeter with resistance of similar wire in its circuit was used to measure the pressure, and a series of incandescent lamps was connected in parallel with the same to check the reading.

1. Small white cur ; weight 21 pounds. Connections from right fore leg to left hind leg, using cotton waste saturated with solution of zinc sulphate with density of 1·10, held in place by wrapping with bare copper wire. In all experiments the electrodes were saturated with the same solution. Resistance, 2,700 ohms. Contact for 10 seconds under 100 volts pressure at 2.46 p.m. Died without sound or struggle.

2. Large black mongrel Newfoundland dog ; weight,

87½ pounds, Connections from brass plate electrode, 4½ × 6 inches, covered with felt ⅜-inch thick, placed on middle of forehead; second electrode on right hind foot in same manner as in previous case. Resistance, 2,200 ohms. Contact for 15 seconds under 800 volts pressure at 3.12 p.m. Died instantly without sound or struggle.

3. Liver-coloured mongrel bird dog; weight 60 pounds. Plate electrode on back of neck and wire electrode on right hind leg. Resistance, 2,200 ohms. Contact for 10 seconds under 700 volts pressure at 3.41. Death instantaneous without sound or struggle. Resistance after death, 250 ohms.

4. Small yellow dog, weight 35 pounds. Plate electrode on forehead and wire electrode on right hind leg. Resistance, 470 ohms. Contact for 10 seconds at 500 volts pressure at 4.01 p.m. Died without sound or struggle. Resistance after death, 488 ohms; increase probably by drying out of solution under wire electrode, as same steamed during time of contact.

5. Calf, weighing 74 pounds. Connections from right hind leg to plate electrode on back of neck; hair saturated with solution but not clipped. Resistance, 500 ohms. Contact for 15 seconds under 800 volts pressure at 4.22 p.m. Died without sound or struggle.

6. Calf, weighing 102½ pounds. Connections from plate on forehead to right hind leg. Resistance, 550 ohms. Contact for 20 seconds under 800 volts pressure at 4.44 p.m. Died without sound or struggle. Resistance after death 280 ohms.

7. Calf, weighing 98 pounds. Connections same as with previous experiment. Resistance, 340 ohms. Contact for 15 seconds under 800 volts pressure at 4.55 p.m. Died without sound or struggle. Resistance after death 230 ohms.

8. Calf, weighing 109 pounds. Connections from right fore leg to left hind leg. Resistance, 380 ohms. Contact for 20 seconds at 800 volts pressure at 5.06 p.m. Died without sound or struggle. All of the calves were dressed by the butcher, and were pronounced fit for food.

9. Horse, weighing 830 pounds. Connections from plate electrode on forehead to left hind leg. Resistance, 500 ohms. Contact under 1,000 volts pressure for 25 seconds, at 5 25 p.m. Instant death without sound or struggle. Resistance after death, 200 ohms. Some time after death circuit again closed to ascertain whether muscles would still respond to action of current; muscles were made rigid during continuance of current, and relaxed as soon as circuit was opened. In each case the muscles of the subjects stiffened when circuit was closed; after about five seconds they gradually relaxed. Number of alternations, 288 to 300 per second. The experiments were under charge of Dr. Carlos, F. MacDonald, and others, representing the State, assisted by Dr. A. D. Rockwell, Dr. Edward Tatum, Mr. A. E. Kennelly, and Mr. Harold P. Brown.

WIRING BUILDINGS FOR ELECTRIC LIGHT.*

By J. D. F. ANDREWS.

THE first points for consideration in devising a wire system for electric lighting are what contingencies will be met with that will affect the system, and what faults will arise in it after its introduction.

Through past experience it has been found that the practical pressure of electricity for electric lighting is within 50 per cent., either way, about 100 volts, the 100 volts being most generally adopted. The chosen conductor is copper, and the most widely adopted insulation is India-rubber in many modified forms. The insulated conductors are usually protected and held in position by wooden casing. We need hardly question the object of the conductor; but what is the object of the insulation? The conductors, if held in good dry wood casing only, would be well enough insulated, and would be protected from interference. Its object is to meet one of the worst contingencies, moisture or water, which is an ever working evil on electric light wires. If you place a copper wire in water with electricity passing along it the copper will be removed electrolytically from the part of the wire where the electricity enters, and deposited where it leaves. The same process goes on when uninsulated or badly insulated electric light wires lie in water or surrounded by moisture. Even though no electricity is flowing through a copper wire exposed to moisture and the atmosphere, it is acted upon chemically. The result of the electrolytic and chemical actions on electric light wires is to thin them and make them insufficient for carrying the current, and consequently they become heated; or the result may be that the wire is eaten through, when an electric arc is produced. This effect or fault is called an opening circuit, and is about the most difficult and dangerous fault to contend with. It is usual to lay the electric light leading wire in a groove in the casing neighbouring and parallel to the return wire. Water often saturates the casing between them, and when the insulation is poor the electricity will pass through the moistened wood and char it, often setting it in flame. Faults such as this, where a great leak is taking place between the wires, are called partial short circuits, and are equally difficult to avoid and as dangerous as opening circuits. The study of the insulation of the wires is therefore obviously of great importance. Most of the results in good insulation were obtained by telegraph engineers before the electric light business was started; but in the new business these results were almost entirely ignored.

Great insulation was then not considered necessary, and special covering for the wires was devised of a cheap and poor quality, which it is greatly to be regretted has continued in use by many contracts to the present day. As previously stated, India-rubber is the base of the insulation of most electric light wires, the purer the material the better the insulating properties; but pure India-rubber is easily influenced by air. At first it gets hard, and in course of time changes to a soft sticky state, when it is useless as an insulation. Pure rubber is still the foundation of insulation on the wires, but in the very best qualities it is protected from the atmosphere by an outer coating of what is known as vulcanised India-rubber. Such qualities of insulation consist of first one or two lappings of pure rubber, then a layer of India-rubber mixed with such minerals as soapstone, over which again is laid a coating of rubber mixed with a large proportion of sulphur. The wire, with its three coatings, is now subjected to a high temperature in a vulcan by means of steam, through which the rubber and sulphur combine, while any surplus sulphur is absorbed by the middle coat, which is called the separator. Such is the insulation of the best quality wires. The inferior qualities, and those most generally used, are insulated simply with pure rubber and cotton serving, with ozokerite or other compound tape laid together in many different ways, according to the device of the maker. The compound tape is supposed to protect the pure rubber from the air, but it only plays this function to a small extent. The usual reliable life of such wires is from two to three years; and not being reliably waterproof throughout their length at any time, there is always danger of failure through moisture. Vulcanised India-rubber covered wires of the class above described (there are many inferior kinds) are perfectly reliable in water or air for a great number of years.

The next contingency that has to be contended with is mechanical damage. The wires being more or less flexible and the covering soft, they are easily damaged. This difficulty is usually met by casing the wires in wood; and it being necessary to employ two conductors for electric lighting, the casing has two grooves, one for each conductor, a cover being fixed over them. Wood casing has the disadvantage of harbouring moisture. Another method of protecting the wires is that of sheathing them with an outer covering of wires as introduced by the writer some years ago into ship lighting. This method protects the wires much more effectually than casing, and does not harbour moisture. Iron pipes have been used in many cases, and are an excellent protection, but moisture collects in them; and if there should be a fault in the insulation it is sure to find it.

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* Read before the Glasgow Philosophical Society.

There is another fault besides the opening circuit and partial short circuit, not yet touched upon, namely a dead short circuit or a direct contact between the opposite conductors. This is the most frequent fault, and if it were not that there is a simple appliance, called a fuse, to meet it, it would also be the most dangerous fault. Short circuits usually happen in the fittings, where the opposite conductors are necessarily brought nearer each other, and at these points the insulation is generally much thinner and poorer. Short circuits also often happen when the wires cross, and frequently by connection with gas or water pipes, which make very complicated faults, because the two wires usually touch the pipes a distance apart, which will be better understood by reference to diagram 1.

Suppose the current to leave the dynamo by the positive wire, pass to the lamps by the branch wires, and back by the negative branch wires through the fuse, F, and the negative main to the machine. Suppose, now, the positive branch becomes connected to a gas pipe at, say, A, this would not indicate itself in any way, and the installation would, of course, continue working just the same, until the opposite wire got connected to the gas pipe, say at B. Now the current will become excessive, more than the branch wire can carry without getting dangerously hot, before the main fuse, T, melts. In the above description it is assumed there is a safety fuse at F; but it will be observed the short circuit has bridged the wire in which it is inserted, and it is consequently useless. To avoid the excessive heating of the wires with such faults above referred to, it is necessary to have fuses, one on each wire, such as at F and S. Under such circumstances, when a short circuit such as described between A and B takes place, the fuse, S, would immediately blow and prevent danger. Let us again assume there are fuses on only the negative wires, we will see there might have been even a worse fault. Again, supposing a connection at A with the gas pipe, which is, of course, connected to the earth, we will assume the second connection to take place in the dynamo field magnets at C. The current will now traverse the positive wire to A, thence to the gas pipe to earth and back to the dynamo. This route is a short circuit, and one moreover that bridges both branch and main fuses, which we have assumed to be only on the negative wire, as is still the practice of some contractors. The consequence of this short circuit is similar to the one from A to B, but worse, because there are no fuses at all left to protect the system. Of course, with another main fuse on the positive wire such a short circuit could not continue.

FIG. 1.

FIG. 2.

There is, however, objection to the multiplication of fuses; they are a danger themselves sometimes, such as in the case of a partial short circuit that does not increase the current sufficiently to melt the fuse, but quite sufficient to heat it to a degree dangerous to any inflammable material in the neighbourhood, and it may continue in this condition some little time before it fuses, especially if it is a large one. Another point of danger from fuses is, when it melts it throws out sparks of molten metal. Of course it will be said that these evils in fuses can be reduced by proper construction; that is true, but it is decidedly better to avoid, if possible, numerous points of danger in an installation resting on special construction, or the care of an attendant for their prevention; we will consider later how this, to a certain extent, can be achieved.

In the foregoing we have considered mainly the contingencies or dangers arising with the introduction of electric light into buildings and we may summarise the main points as being, an opening circuit, a partial short circuit, a dead short circuit and the fuses. We have considered the dead short circuit to be met by the fuse; although a new element of danger is introduced which, however, is much less in degree. This new element of danger can be reduced to one-half by connecting one of the leading wires, say the positive, to the earth and the gas and water mains, it being only on account of the latter that it is otherwise necessary to provide a fuse on each wire. Diagram 2 will show this more plainly. The current leaves the dynamo by the positive terminal and meets at once a connection to earth and the gas and water mains, then proceeds by the positive wire to the lights and back to the dynamo. This connection to earth is wilfully effecting the fault we suppose might happen, as in diagram 1. But in making the connection to earth we are careful to do so with that wire which has not got the fuses inserted in it, which is contrary to the action of the fault in diagram 1. Now, if any of the negative wires come in contact with the gas and water pipes, a fuse must instantly blow, as if the two conductors themselves had touched. All the electric light fittings would in this case be connected with the positive wire, the negative wire passing down the centre of the tubes. There being in the fittings only a single wire which can be heavily insulated and made stouter, there is an additional safety against short circuits and fuse melting, besides the very great advantage of being able in a very simple way to wire each part of an electrolier or fitting. Diagram 3 illustrates how this is effected. The current travels from the contact, A, down the wire, B, through the contact, C, to the switches, S, S, by the wire, D, to the lamp, L, and back by the brass of the fitting to the ball and socket at the top and away by the earth wire. The wire inside the tubes is never smaller than No. 14 S.W.G., and the contacts are made with a strong small spiral spring. The contact at the ball and socket joint projects through, and being a box spring, it gives and takes with the swing of the fitting and scrapes on a fixed brass plate in the roof plate. Single or universal joints are quite simple to construct with this system within the same dimensions as for gas, whereas with the two wires passing through the fitting such is impossible.

This method of connecting one of the wires to earth is best called the earth system; it is, however, often called the single wire system, because in its application to ships the hull of the ship is used as the return wire. In buildings, however, two conductors are required, and as it is important always to be able to distinguish between the negative wire in which the fuses are inserted and the positive wire which is connected to earth, and all the electrical fittings, the positive wire is coloured red and the negative wire black. The object for connecting the positive wire to earth is that red coloured wires are usually inferior in insulation quality to black wires, and it is not so important that the return or earth wire should be so highly insulated as the leading wire.

We now come to the consideration of means for minimising those most dangerous faults, opening and partial short circuits. Except the means proposed by the writer in the following paragraph no attempt has been made to treat these faults except by good workmanship and material. The proposal the writer makes is to universally adopt the sheathed or armoured wire system devised by him some years ago for use in the exposed and damp places on board ship, using the earth wire system, and now extensively used for that purpose. The virtue of this system is that all faults, partial short circuits and opening circuits, are reduced to dead short circuits. Fig. 4 is an enlarged section of an armoured wire, such as is now in use. The pink portion, C, is the copper conductor; I is vulcanised India-rubber insulation of the highest class, with a serving of jute and special compound, S, between it and the iron armouring, Q, which is a great many times larger in cross section than the copper conductor, care being taken that it is always more than seven times larger, this being about the difference in electric conductivity of the two metals. It will be understood that the copper wire is the lead and the iron wire the return. It was assumed in devising this system that the opening circuit in the outer conductor was very unlikely to take place, and so it has been found in practice. It is, however, possible that the inner conductor, through undue strain or a flaw, might have an opening circuit in it; and if such were to take place the immediate result would be that the heat generated would destroy the insulation between the two conductors and at once effect their fusion together and a short circuit. As a matter of fact, however, short circuits in this system have in practice been many fewer, and there have been no opening circuits or partial short circuits. How many of the short circuits were due to such faults is difficult to say; the causes of some were doubtful.

FIG. 3. FIG. 4. FIG. 5.

The writer is not aware of any new danger or contingency being introduced with this system of concentric wiring, although he has heard that some people object to it, and, in fact, to any system in which an earth connection is introduced; but he has still to learn upon what grounds the objection is based.

In addition to the advantages above referred to, there is another, not of least importance. The electricity being entirely enclosed within the outer conductor, and the electric pressure being only from the centre point to the outer conductor, it is impossible to get a shock through anything more than a very small part of one's flesh, such as the finger end, except by wilful contrivance.

It is advisable before closing this subject to consider how a system of wires supplying a town would be effected by an earth connection of one of the conductors. With any system of supply embodying the series system I may generally say it is not advisable to employ an earth. I have expressed this point broadly, as it involves complex considerations which would take long to make quite clear. But with all systems on the parallel system there are many points favourable to an earth connection, some of which can be gathered from foregoing descriptions. It is now important for us to find out whether there is any objection to its use, and with this in view diagram 5 is placed before you. It illustrates a transformer with its primary leads, and an electric pressure of 2,400 volts at the terminals, A and B, where they join the primary circuit, 1, of the transformer. F is a fuse in the primary circuit. 2 is the secondary circuit of the transformer between the terminals, C, D, of which there is represented a pressure of 100 volts. The terminals, B and D, of the circuits of the transformer are connected to earth, and consequently connected together. The writer is unable to find any danger in thus connecting the 100 volt pressure circuit to the 2,400 volt pressure circuit. Nobody could get a shock to earth, because the pressure between the return wire and earth is reduced to *nil*. The next point is, is there any greater probability of the insulation of the transformer breaking down because the circuits are joined together at one end. This seems to the writer to be answered by a simple calculation. With the earth connection there is no pressure at one end, but all the pressure, whatever it is, at the other. With no earth connection the pressure is alike at both ends, but at each it is only half the total. The result in both cases is the same. Suppose a connection did get made between the terminals, A and C, in addition to the earth connection, why the 2,400 volt circuit would be simply short-circuited, and the fuse, F, would melt. There is, it is true, a very remote possibility of danger in the event of the great improbability of three circumstances happening in succession—namely, first of all, a connection between the terminals, A and C, as well as the earth; then the fuse, F, not melting; and, thirdly, the circuit of the secondary of the transformer to open between the terminals, and thus put this 2,400 volts pressure on to the lamps direct, which would, as a matter of course, immediately gasp their last.

There is one other circumstance worthy of mention in favour of earth connection. Should the wire system at any time be struck with lightning, there is at once a safe connection to earth, instead of having to pass through a highly insulating material, as when there is no earth connection. Lightning has already been known to strike overhead electric light wires and discharge itself through the dynamo to earth, to the imminent danger of the machine.

THE SOCIETY OF ARTS' MOTOR TRIALS.

BEFORE a somewhat scanty audience, on Wednesday the 27th ultimo, the adjourned meeting of the Society of Arts was resumed for the discussion of Prof. A. B. W. Kennedy's paper on "The Objects and Methods of the Society of Arts' Motor Trials."

Sir Frederick Bramwell, Bart., F.R.S., occupied the chair, and opened the discussion by remarking that the paper was certain to be a valuable one, not only for its intrinsic merit as to the proper mode of testing gas and steam-engines, but in exhibiting how great an improvement had taken place, of late years, in the methods of carrying out engine trials. In early days there were no trials at all. Then afterwards trials gave certain results, but did not give any explanation of the causes of these results, why some were successful and others failed; nor did they indicate in any manner where the manufacturers might improve their machines, or in what direction we might look for economy. At the trials of the Royal Agricultural Society held at Cardiff, some years ago, provisions had been made for taking samples of the gases from the smoke-boxes of the engines, but the Council did not consider that the advantages to be gained by the analysis of the gases would warrant the expenditure attendant thereon; the hermetically sealed samples had therefore become rather good specimens of old gas in bottles, and rather crusted. Now-a-days the value of such a trial, as the one under their notice, was well understood, and much scientific knowledge could be deduced from the results obtained. A greater degree of exactitude had been reached by the judges than had ever been attempted before, while the trials had been encumbered with the new condition, that the motors must run with sufficient regularity for the purposes of electric lighting. In the trials of the Royal Agricultural Society it was only requisite that an engine should be fairly self-governing, and did not comprehend the extreme steadiness asked for at the present day for electric lighting. Prof. Kennedy and his colleagues had, therefore, greater difficulties to contend with than usually prevailed. Sir Frederick hoped that, although he considered the trials most complete and satisfactory in all respects, some suggestions might be made for improvement or simplification in the future. It was no part of this Society's business to spend any considerable sum of money on one branch of science; it only initiated things of this kind, and then turned them over to other bodies to take up. Still, he thought that this Society might again repeat its proposition for similar trials, and it was to be hoped that the offer would meet with a more numerous response. The engineering profession, as well as the Society of Arts, owed a debt of gratitude to the gentlemen who had carried out the motor trials, and he should be glad if the evening were utilised on the lines laid down by the paper.

Mr. W. H. Preece, F.R.S., followed the Chairman. He said that he judged there had been very great interest taken in the trials, from the fact that he had been unable to obtain a copy of the report, which had attracted so much attention from the engineering world. The main idea in having these trials was to give encouragement for the production of a small class of motors of, say, 4 or 5 horse-power, suitable for isolated installations of electric lighting, which motor could be easily erected, and would work with a minimum of trouble for personal attendance. Gas not being always procurable in the country, a small steam engine would be an immense boon. It was a question, owing to a considerable amount of advertising, whether petroleum was not better than either gas or steam for producing power. The number of engines sent in for competition was disappointing, and their horse-power was higher than was anticipated. The results of the trials would enhance the confidence in gas engines, the fact having been made patent that from an economical point of view gas, which had generally been deemed expensive, compared most favourably with steam. From his own experience of the cost of gas engines in lighting his house, he found that a horse-power cost £10 per annum; a steam-engine horse-power might at a fair estimate be set down at £7 per annum. The cost of gas as against steam was £10 to £7. Against this difference there would be the saving in labour for attendance on the gas engine and the convenience of starting it at a moment's notice. The series of tests carried out by the Royal Agricultural Society at Cardiff and Newcastle had been criticised, and the figures had always been questioned. The brake used here defied criticism, and he had never heard anyone question the accuracy of the deductions from it. He did object, however, to the use of the term horse-power for an arbitrary unit, introduced by Watt, in place of the pure mechanical unit used in the electrical profession, called the watt. He hoped to see the Society of Arts in the future sound the death-knell of horse-power, and speak of power in watts. He would like to call attention to the striking fact of the variation in the quantity of heat rejected in the water jacket of the different engines. Of the heat developed by the explosion, 43 per cent. by the Crossley and 22 per cent. by the Atkinson was rejected in the water jacket, which showed there was something in a gas engine which still required investigation. They were told that the heat developed in the cylinder of a gas engine had a temperature of 2,500° Fahr., which, if there were any substances in the gases, would give a most brilliant light. His contention was that these substances should not be present in the gases, as they absorbed heat, which radiated to the jacket and increased the temperature of the water; this loss of power might be avoided by using purer gas.

Mr. Davey said that Mr. Preece had spoken on the loss in the water jacket, a subject to which the late Dr. Siemens had paid great attention, and had proposed to surround the cylinder by a non-conducting material; the speaker thought that some improvement might be arrived at in this direction, and again, something might be done by mixing the charges and delivering them under pressure to the cylinder; the trials he made himself to this end had not been very successful.

As one of the competitors, Mr. Atkinson was much gratified by the result of the trial. He was of opinion that the smaller loss in the water jacket of his engine over the other gas engines was owing to the work being done three times as rapidly as by any other engine at the trial. With the intense heat developed the greater the speed at which the work was done the better, and hence the lower percentage of loss. The temperature of an explosion was very high, the work was performed in a short space of time, and a considerable amount of heat was transmitted through the walls. The heat had to get into the walls in the first place, and that he considered difficult. A trial had been made of condensing steam in cast iron pipes; one pipe was smooth inside and out, the other plain inside, but corrugated outside, to present a very large cooling surface. Both these tubes were placed in one tank, and the same pressure of steam turned into both; the result of the experiments was to show that the plain tube condensed precisely the same quantity of steam as the corrugated one, and that the limiting resistance was the skin resistance in passing the heat in to begin with. Mr. Atkinson contended that part of this heat is given back again to the cylinder, whose wall it was unable to penetrate more than skin deep, in consequence of the work being done so rapidly. The Griffin engine afforded an interesting example of the effects of surface in reducing the pressure in the cylinder; the Griffin having a double action, it was found that the piston rod surface brought down the pressure some 6 to 8 lbs. below that in the back part of the cylinder, when the engine was running at full power, increasing to 14 lbs. when it was running light. By using Dowson gas instead of lighting gas the expenditure of coal per indicated horse-power has been brought as low as 1·11 lb., half that of a steam engine.

Mr. Emerson Dowson stated that these trials had created the greatest interest in France and Germany, where they were highly spoken of. He regretted that there was no available means of measuring the quantity of air used, as that might possibly have thrown some light on the disputed point of the combustion being complete or not in the Atkinson engine.

Mr. Druitt Halpin was sorry that a Moscrop recorder had not been used for giving a continuous record of the pull of the spring balance, that no mention had been made of the boiler with the exception of certain temperatures, when the proportions and dimensions would have been of the greatest service for engineers.

Before calling upon Prof. Kennedy for his reply, Sir Frederick Bramwell said he should like to read an extract from the report of the Royal Agricultural Society at the Cardiff meeting in 1883, in which one of the reporters says, that in reply to a question what was a horse-power, he pleaded ignorance, not knowing the kind of horse-power the questioner meant, and that there were five kinds of horse-power, viz.: 1. The real horse-power of 22,000 foot pounds per minute. 2. James Watt's horse-power of 33,000 foot pounds. 3. The gross indicated horse-power. 4. The net indicated horse-power or gross indicated, less an allowance for friction; and 5. The nominal horse-power.

This brought the remark from Mr. Preece that the Chairman had just given five admirable reasons for abolishing the term horse-power.

On behalf of himself and colleagues, Prof. Kennedy said he had to thank Sir Frederick Bramwell and the members present for the kind reception of his paper, and the general satisfaction the trials themselves had given. On the point of rejection of heat by the water jacket it came to this, that the heat had to be got rid of either by the water jacket or the exhaust, and it practically depended in its proportion in the time allowed for it. In the Atkinson engine, the speed of stroke being higher than in the other engines, the greater part left the engine by the exhaust, and he still thought that Mr. Atkinson did not get the whole heat of combustion out of the gases in time to be utilised. Mr. Dugald Clerk, he believed, had fitted a window to a gas engine cylinder and had seen the white flame, but he had never seen it himself. If they could only have measured the air and the temperature, the trials would have been absolutely complete. In future he thought he could measure the temperatures, but the air measurements would still remain a difficulty. He much regretted that the dimensions of the boiler had been overlooked, but they would appear, with other additional matters, in the reprinted report. As to the difficulty of measuring feed water on board ship, he never had much trouble except in stormy weather, but he had always made use of conical tanks tapering upwards.

PROBLEMS AND CONDITIONS OF OCEAN TELEGRAPHY.

Sed te, mihi crede, memento
Nunc in pellicula, cerdo, tenere tua.
MARTIAL.

ALTHOUGH the foregoing lines not inaptly express our conviction, and in quoting them we might justly close this discussion, yet there are certain points in Judge Weatherbe's contribution to our correspondence columns on March 22nd, with regard to which we consider he may benefit by devoting some of his legal acumen to the suggestions we are about to proffer. And we feel confident that such attention will result beneficially to our correspondent, since it would appear that he, probably through some oversight—and even the greatest legal luminaries have been known to err—has not only misquoted us, and has wrongly interpreted our meaning, but has also judiciously attempted to give a different direction to the discussion, and to avoid certain unstable ground unwittingly approached by him in his original communication.

A critic has not an altogether enviable life: here we are committed, in a degree, to act upon the defensive, merely because we have ventured to doubt the wisdom of giving up the old love before we are thoroughly "well on" with the new; "*caveat emptor*" is a maxim certainly applicable to the present case.

Our correspondent has evidently read a great deal, and has posted himself in the history of submarine telegraph operations, as he, indeed, informs us, and he deserves every credit for having dedicated the time he could spare from his judicial duties to submarine telegraph research; but this fact scarcely confers upon him any peculiar privilege in the capacity of a judge upon the respective merits and defects presented in various types of cables. Moreover, it would appear that our correspondent takes up the position of a judge in this question, while, as a matter of fact, he is nothing but an advocate. There are many men who have not only had the advantage of extensive reading, but who have also had the benefit of a large practical experience in submarine cable work, and the consensus of their opinion is such that we would recommend to Judge Weatherbe a more careful consideration of the history of submarine telegraphy, if, as is not unlikely, he still refuses to admit the validity of any argument opposed to his own particular ideas.

So much for the ethological conditions of the discussion; we will now proceed to deal with Judge Weatherbe's communication from the practical point of view.

We cannot permit our correspondent to treat the question of shore end cables in quite so summary a fashion as he would desire. In his original letter he distinctly drew a comparison between the endurance of a hempen cable laid in a sheltered harbour, and shore end cables as generally situated. He said:—"This cable, subjected to all the dangers incident to shore ends," &c. We naturally pointed out that the comparison was in no respect an equitable one, and now, in the judge's communication to our pages, he attempts to ignore the statement he had previously made.

Our correspondent would lead us to believe that there can be no possibility of any mechanical injury occurring to cables situated in deep water. Well, "deep water" is a sufficiently vague expression, but we presume that a depth of over 1,000 fathoms will come within the limits of the definition. It is precisely to such mechanical injury, produced by the volcanic or coral formation of the bottom, that we referred to when speaking of the West India cables. We stated that the damage was "not due to any inherent defect in iron as being subject to corrosion, but to the exceptionally dangerous character of the bottom." This statement has been so misquoted by our correspondent, as to admit of a very different interpretation.

We consider that the fact that cables sometimes assume a birdcage like appearance enters into the discussion, with all due respect to the judge's opinion to the contrary, since it takes place through the hemp bedding underneath the sheathing wires having been eaten away by insects; and this has frequently taken place, notably, in the Irish Channel cables, in comparatively shallow water, and in the Mediterranean at a depth of 1,500 fathoms. Had it not been for the iron sheathing no portion of these cables would have been recovered.

By-the-bye, would our correspondent inform us as to the locality where he has found that corrosion not only destroys the sheathing, but also, as he says, "the contiguous core?"

As to the rotting of the hemp, a possibility which our correspondent does not seem to admit, the report of a Parliamentary submarine telegraph committee, when sifting the evidence obtained as to the preservation of hemp, stated that this material "has been found too weak after long immersion to enable cables to be raised from much depth, and has been frequently eaten away by marine insects, and *injured by marine vegetation*," &c.

It has been discovered, in the course of many experiments, that the hemp in shrinking distorts the gutta-percha, and as the conductor cannot shrink in unison with the gutta-percha, the copper wires are knuckled and forced out. While a cable of this description is new, no doubt that the compound or tar made use of as a preservative will for a short time prevent the assimilation of moisture by the hemp, but the hygroscopic nature of fibrous materials is well known, and it is a matter of practical experience that the water gradually forces out the preservative compound or tar, with a result necessarily fatal to this type of cable.

As Judge Weatherbe states that he has before him all the evidence we possess, we would advise him to refer to the Proceedings of the London Society of Telegraph Engineers, where he will find some details as to the action of tar and similar materials upon gutta-percha.

Our correspondent is incorrect in stating that we did not refer to the laying of hemp-covered cables. We said "that hemp-covered cables can be laid, no one has disputed;" it was consequently quite unnecessary for us to further comment on the experiment made in this direction, and on which the Judge lays so much stress.

As a matter of fact, a hemp-covered cable was laid between Candia and Alexandria in 1858, and so far as the laying was concerned, no particular wonder seems to have been expressed with regard to the operation, consequently our correspondent's remark that "yesterday" it was believed that a hempen cable could not be sunk, would appear to be chronologically inaccurate.

To complete, for the benefit of Judge Weatherbe, the history of the Candia-Alexandria cable, it was found that hemp-eating insects had damaged the covering, injuring the cable mechanically, and it was further discovered that the hemp covering did not impart sufficient strength to permit of the cable being *raised* in 1,750 fathoms. Our correspondent may object to this testimony as being somewhat out of date, but so far as the public is concerned, here is direct and well authenticated evidence against hemp-covered cables. On the other hand, what is known, except to those immediately concerned, of the results attending the introduction of 50 miles of hemp-covered cable into one of the Atlantic sections? Has this particular type been grappled for, and if it has been successfully raised, why does not our correspondent say so, instead of indulging in such loose talk as "I will pledge myself" to do this or the other thing?

Judge Weatherbe has gone out of his way to indignantly protest against any connection between "stagnant water" and Halifax Harbour. Now, we never even thought of such a connection (with regard to the harbour be it understood), much less did we suggest the idea in any way. It is simply devoid of common sense for the Judge to suppose that any one could for a moment hold the opinion that in any harbour where there is probably a rise and fall of tide, "stagnant water" could be found to any extent. It is easy enough to set up a cocoa-nut for the purpose of knocking it down, but one should not set it up so far off, that one not only misses the nut but also loses the stick.

As to the automatic grapnel by which the hooking of the cable is immediately known to those on board, we can assure our correspondent that we have heard about it, and we can also assure him that it has not as yet secured that general employment which it possibly deserves. We are slow, no doubt, but we do not like to jump at conclusions too blindly. Let us first have some substantial proof of the success of the automatic grapnel, the patent grappling rope, and the hempen cable, *when the latter has required repairing.*

To revert again to the durability, or want of it, of hemp covered cables. Of the many hemp eating insects we presume that the *xylophaga*, described by Prof. Huxley as being closely allied to the teredo, is one of the most destructive. To the ravages of this insect the failures of the Candia-Alexandria, and Candia-Syra cables were due. This insect does not attack gutta-percha.

If all experiments in the direction of very light cables are to be taken into account, why not adduce the circumstances attending the laying of the Channel cable in 1850, and the Varna-Balaclava cable in 1855? In both these cases unprotected gutta-percha was employed and these cables were successfully laid, just as was the case with the 50 miles of hemp-covered cable which Judge Weatherbe tells us was put into the Brest-St. Pierre Atlantic cable. These cables lasted but a short time, and were never successfully repaired. In the latter instance, we may mention, iron sheathing was used for the "stagnant water" of the shore ends, and the extremely shallow portions.

The experiment made by Judge Weatherbe on iron wire is very interesting, but, so far as we can see, it only goes to prove that if you subject a cable to strain and torsion, and cut into the sheathing to a sufficient depth, the wires will break. If they be sufficiently hard, so as to describe the gymnastics our correspondent describes, they will naturally unlay, to the disadvantage of the core. How far these facts go to prove anything in favour of hemp-covered cables as possessing a longer life than sheathed cables, we will leave our readers to judge, only adding that it is not unusual to see a hemp rope behave in the same manner when similarly treated.

It is hardly fair to cite as examples, the first and the 1865 Atlantics, as the iron wires in both cases were not galvanised. Iron wire for submarine work requires galvanising, just as tar appears to be necessary to the Judge's Russian hemp. With regard to the depth likely to be met with in a Pacific cable route, we really are not responsible for Mr. Sandford Fleming's statement that a depth of 3,300 fathoms must be encountered. Admitting that gentleman is correct, there is only a difference of 600 fathoms between the depth on the Pacific route and the depth in which more than one of the present Atlantic cables is laid in; and if we take the case of the cables connecting Europe with Brazil, a difference of not much more than 300 fathoms will be found between the depths in which they are laid and the depth on the Pacific route. It is about time that the vague talk about the immense depths in which a Pacific cable must necessarily be laid, should be silenced. No doubt there are here and there exceptionally deep spots, but is it not well known that a depth of over 4,500 fathoms is to be found in the North Atlantic, and does it follow that the existing Atlantic cables must have been laid through this deep patch?

As to the various proposed Trans-Pacific submarine routes, we believe that the following is a correct summary of the different schemes so far as they are known to the public:—

Proposed by	Total length of cable. N. M.	No. of sections.	Greatest length of any section. N. M.	Maximum depth on any section. Fms.
F. N. Gisborne......	3,795	3	1,485	3,000
Sandford Fleming	7,150	4	2,530	3,300
Cyrus W. Field.....	5,907	3	2,277	3,100

Now some of the present Atlantic cables are laid in a maximum depth of certainly not less than 2,700 fathoms, and, as we have already stated, the cables between Europe and Brazil are laid in a maximum depth of about 2,900 fathoms; it is a curious commentary on Judge Weatherbe's fanatical advocacy of hemp-sheathed cables, that on the Brazilian lines above referred to, those portions of the iron sheathed cables which have given least trouble are precisely those which are laid in the deepest water.

As to "the" route, which Judge Weatherbe flatteringly calls "our" route, we have none, it is not our business, and we would again refer him to the charts of the Pacific Ocean, when he will discover that the depth we quoted need not be exceeded, and that to strike the abnormally and occasional deep patches considerable deviation from a natural line must be made.

We cannot dismiss the subject of light covered cables without referring to the Oran-Carthagena section laid by Messrs. Siemens in 1864. This cable consisted of the usual gutta-percha core covered with two reversed coats of hemp, with an external protection of a ribbon of copper alloy. This cable was only laid in part, as the numerous accidents, due to its want of tensile strength, which occurred during the laying, determined the contractors to abandon the enterprise. We may add that, although the cable was grappled for during three weeks, it could never be raised to the surface.

While pointing out some of the objections to the exclusive adoption of hemp-covered cables, we can assure Judge Weatherbe that he is correct in assuming that we have still greater objections to his method of treating the subject, and we have criticised it perhaps somewhat severely, for we consider that the dissemination by an enthusiastic advocate of insufficiently weighed statements can only lead the public astray.

From the general tone of Judge Weatherbe's communication, it would appear that he considers himself alone entitled to judge the case; perhaps this is another example of habit becoming second nature. We hope that should our correspondent favour us with any further contributions on the very interesting subject of submarine telegraphy, he may give us less of his individual opinion, and bring forward such evidence as will enable our readers to place some reliance upon his statements.

We have refrained from making any detailed mention of the suggested retardation in signalling due to the presence of iron sheathing, since Mr. Kennelly, in our issue of last week, disposes of the theory advanced as to loss of speed.

We offer our correspondent, as the "retort courteous" to his opening lines, the following maxim: "Judicio est judicare secundum allegata et probata."

ELECTRIC LIGHT PROVISIONAL ORDERS.

BOARD OF TRADE INQUIRY.

MAJOR MARINDIN, on behalf of the Board of Trade, opened an inquiry at the Town Hall, Westminster, on Wednesday morning, into a number of applications by various electric lighting companies for provisional orders for the supply of electric lighting, chiefly in the metropolis. The following counsel and other gentlemen appeared for the several companies and local authorities interested: London Electric Supply Company, Mr. Pember, Q.C., Mr. A. K. Lloyd, and Mr. J. C. Graham; Metropolitan Electric Supply Company, Mr. C. A. Cripps; Electrical Power Storage Company, Mr. Moulton, Q.C., and Dr. Hunter, M.P.; Chelsea Electricity Supply Company, Mr. Moulton, Q.C., and Mr. R. S. Wright; Strand District Board of Works, Mr. Cripps and Mr. F. M. Jenkins; Greenwich District Board of Works, Mr. James Spencer; Paddington Vestry, Mr. J. H. Horton; St. Olave's Parish, Mr. Bailey (clerk to the Vestry), and Mr. Thompson (surveyor); Great Eastern Railway Company, Mr. E. Moore, solicitor; St. James's Electric Supply Company, Mr. Muirhead; St. George's (Hanover Square) Vestry, Mr. Hitchins; Notting Hill Company, Mr. Roger W. Wallace; City of London, Mr. G. Prior Goldney (City Remembrancer); Marylebone Vestry, Mr. Cripps and Mr. Greenwell; Lambeth Vestry, Mr. H. J. Smith and others; Westminster Supply Company, Mr. Roger Wallace, London County Council, Mr. J. Percy Gunyon, engineer, and two members of the Council; St. James's (Westminster) Vestry, Mr. Wilkins (clerk), and Mr. W. Jenkins, chairman of the lighting committee; Holborn District Board, Mr. Hopwood, solicitor; St. Martin's-in-the-Fields, Mr. Webster Murnane (clerk); St. Pancras Vestry, Mr. T. E. Gibb (clerk), and Prof. Robinson, C.E.; Kensington and Knightsbridge Company, Mr. Roger Wallace; North London Railway Company, Messrs. Payne, Son, and Pollock; Bermondsey Vestry, Mr. Harrison, solicitor.

Major MARINDIN stated that he proposed in the first instance to consider the applications affecting London.

Mr. PEMBER thereupon explained the nature of the order submitted by the London Electric Supply Company for approval, and the position of the company. This company, he stated, had an authorised capital of £1,250,000; the subscribed capital was about £800,000, while the paid up capital amounted to £585,000. Of their capital they had expended on works and plant £430,000, so that they had in hand about £150,000. Their operations so far showed that this was a substantial undertaking, and that they had not only got the money but were expending it wisely, and in a far-seeing way. The company had already gained considerable experience in electric lighting. Their system was different from that of other companies, because, instead of having a generating station in each separate locality, they proposed to have one large station at Deptford, and from that station to have trunk mains which would carry the light to London along the parapets and bridges of the railway companies, with whom they had come to agreements. The order was originally much more comprehensive than it now was, for they had deleted several districts at first included—viz., St. Mary Abbots, Kensington; St. John's, Hampstead; St. Mary's, Islington; St. Leonard's, Shoreditch; Paddington (partly), St. Luke's, St. George's-in-the-East, Whitechapel District, St. Mary's, Lambeth, and St. George-the-Martyr, Southwark. The company did not ask for any exclusive grant of any district. They did not object to competitors, but were quite ready to see the Board of Trade grant orders to any other persons within the same area of supply. That being so, he thought there were two main questions of principle applicable to their case; first, was it advisable to grant a large area to one company; and secondly, was it advisable to give more than one company powers over the same area. Those seemed to him to be the two questions of principle involved in their case, and they of course answered "Yes" to both. Parliament obviously intended competition. He remembered perfectly well Mr. Stanhope's committee in 1882. The committee discussed the question of competition *versus* regulated monopoly. They rejected the theory of monopoly such as had taken place in the case of the Gas Acts, and preferred to leave the matter open. It was for that reason that they had fixed no maximum price for electricity in the Act of 1882, and it would be obvious that if that was the principle upon which Parliament proceeded, the Board of Trade at all events should be open to consider the question of unlimited competition in one area. If that was admitted, and if that question were answered by the Board of Trade in the affirmative, it was clear that the first question would also be answered in the affirmative, because if it was held advisable to give more than one company powers over the same area, there would be no harm whatever in giving to the company which asked for it as large an area as it thought fit to cover. The possession of a large area over which they could expatiate, and in which they could employ their capital profitably, the hope and chance of a large and remunerative business were a great encouragement to the investment and application of capital provided it was well applied and wisely invested, and conduced to cheapness in the article supplied, and economy in working which in its turn reacted upon possible cheapness. At all events there was nothing in the Electric Lighting Acts of 1882 and 1888 to prevent the Board of Trade from giving effect to this view. The Board had a perfectly free hand, and he hoped they would use it. Mr. Pember next described the works of the company at Deptford, and invited the inspector (Major Marindin) to visit them before the enquiry closed. They were large and compact, and were a thoroughly well considered and largely devised attempt on the part of a company which hoped to be one of the largest purveyors in London, to do something for the London public analogous to what the gas companies had done when they moved from London to Beckton, to the great advantage of the public. They hoped that before long Deptford would become an electrical Beckton. The intended plant of the company consisted of four double engines and dynamos of 10,000 H.P. each, and two smaller engines of 1,500 H.P. each. The two smaller ones would be ready for use a month hence. The first large one would be ready in November, and the second one probably in December. These engines would be amply sufficient to give constantly a supply of 230,000 lights. They could be duplicated, if necessary, very speedily, and, in fact, it was not too much to say that the plant could be multiplied yet further on the existing premises, and the company could give a daily supply of 1,000,000 lights if called upon to do so. Their scheme consisted in carrying trunk mains into London, and for this they had arranged with the London and Brighton Railway Company, the London, Chatham, and Dover Railway Company, the Metropolitan Railway Company, and the South Eastern Railway Company (near which the works were situated), to place these mains along their lines and bridges, so that there would be no breaking up of streets in the suburbs. The current being brought into London, would be distributed to various stations, where it would be converted—the high pressure at which it was brought in being converted into low pressure for private houses. Then it would be distributed by ordinary supply wires to private customers. As to the advantages of this system over other systems, there was the removal of different generating stations out of town to one place in the suburbs, and that would be a great advantage to all the parishes concerned. There would be no noise from moving machinery; there would be no smoke, and no carriage of coal through the streets. It was obvious that the absence of the manufactory itself must be a great boon to everybody, for it was conceded that the nuisance from existing stations in London (such as those at Paddington and Jermyn Street, and the Grosvenor Gallery) had been very great. This company had only avoided lawsuits by assuring people that they were intending to ask for this Order and go to Deptford. Then with regard to coal, if they assumed a parish of 200,000 people supplied with electric light, allowing one light per head, that would mean 200,000 lights, and for the production of the electricity 408 tons of coal per day would be required. That was on the assumption that no condensing engines would be of use in a populous place. To carry 408 tons a day, 200 cartloads would be necessary, and besides those, other carts would be required for removing waste and ashes. In a crowded parish that traffic would be a serious addition to the heavy traffic already existing, and it would moreover cause serious obstruction. Furthermore, sufficient storage would not be practicable under these conditions, and a snowstorm or fog or other cause of stoppage of traffic might prevent the supply and leave the public in temporary darkness. Mr. Pember further pressed the economic gain to be obtained by the concentration of plant and works under one management, by the cheaper land to be had outside London, and by the proximity of the works to the river, so that the company could bring their coal direct in their own steamers to their own wharves. This would reduce the cost of the coal from 20s. or 25s. to 12s. or 15s. a ton. They would also have abundant space for storage, so that they could buy their coal at the cheapest period and take advantage of any lowering of prices, all of which would tend to the benefit of the consumers of the light; and, finally, they had abundant water at their command, and could use condensing engines, which would tend to cheapness of production. Experiments had shown that they would be able to use up to within 4 per cent. of their rated output. Mr. Ferranti, their engineer, would explain the relative advantages of this company's system—the conversion system—over the storage system, which depended on the possession of accumulators and batteries. With respect to the mains they might be described as concentric tubular conductors. There were two cylinders separated by insulation, and the current would go by the inner tube and return by the outer tube. The small tube would be insulated from the outer one, and the insulation provided would prevent any disturbance to telegraphic or telephonic lines. The distributing mains would be comparatively small, and a main capable of conveying power for 100,000 lights would occupy a space of only 2¼ inches diameter. The tubes being thus small, the breaking up of streets would be reduced to a minimum, and on that point the company were perfectly ready to co-operate with any other company who might be serving the same district, so as to secure joint opening of streets. In the next place, their system of distance transmission had been thoroughly well tested at Turin, and a distance of 30 miles had been found to be perfectly practicable for the transmission of electricity for distribution. The distance covered by this order was, of course, far less than that.

Dealing next with the other orders submitted and the attitude of their promoters towards his company, Mr. Pember mentioned that besides the orders, two licences were asked for—one asked for by the Chelsea company, and one by the House-to-House Company. He invited the inspector to consider these matters solely as they affected the London Supply Company, and stated that that company only opposed the other applications conditionally, having no objection to them, and only seeking to show the superiority of the system he had described over all the rest. The other methods did not affect them, except on the one consideration that only one company should be allowed in one area. If that was to be the rule laid down by the Board of Trade, then the company would oppose all those applications, and contend that their own system was the best for the people of London, asking that theirs should be the one system authorised. But if competition was admitted then they were so confident of the superiority of their system that they would not fear the presence of any number of competitors. Passing next to the objections lodged by the various parties, Mr. Pember selected typical examples to show the general scope of the opposition. It was first urged that the period of 42 years, which had been settled by Parliament last year as the term for the acquisition of undertakings by local authorities, should be reduced to 21 years—the period fixed by the Act of 1882. To this he replied that Parliament, and everyone concerned, had felt that 21 years was too short a period, and that enterprise had been crippled by that limitation. The Select Committee, in 1886, presided over by the Earl of Camperdown, had received overwhelming evidence to that effect, and the Board of Trade would not be likely to go back to that limitation. A local authority might be anxious to get hold of a profitable undertaking on easy terms, but Parliament had held the scales between such bodies and undertakers, and had determined that that should not be allowed. That was the meaning of the legislation of 1888 as against that of 1882. The Vestry of St. James's, Westminster, proposed the insertion of a clause forbidding one company from acquiring, or associating itself with another undertaking in the same district. That was more than they were entitled to ask for, and there was already legislative provision upon that subject. It was an open question at present whether undertakers under a Provisional Order should or should not be allowed to transfer their undertaking, and he saw nothing in the Acts of 1882 and 1888 giving express power to do so. At all events, this was a matter to be settled, not by a local authority, but by the supreme authority, and the Board of Trade was abundantly safeguarded against any improper transfer. In the next place the objectors asked that a clause should be inserted requiring the company to satisfy the court as to their financial responsibility and position. To be satisfied on that point the Board of Trade, he should suppose, would consider an antecedent condition to granting an order. But the company did not blink any enquiry on that point, for their position financially was about as sound as that of any company could be. If information was seriously asked for, their witnesses would supply it. It was also suggested that the company should provide in some way a pecuniary deposit, as a guarantee, he supposed, that they would carry out the work. This was a question of degree. If it were a question of depositing some not very large amount—say, £10,000 or £20,000—in respect of the whole order, the company might not raise any great objection; but to give more than that—to give a sum of £500,000, as had been suggested—for every parish would be a very serious matter, and he did not think the Board of Trade would recommend a course which would seriously hamper the finances of any company, however sound its position might be. It was against public policy to lock up a sum of money like that, which might be well employed on the furtherance of the order itself. The next proposal was a provision prohibiting the connection of a circuit current with the earth. This was a question to be decided not by local authorities and once for all, but by the Board of Trade, acting upon the advice of its scientific advisers. Then it was suggested that the distributing boxes should be of a size and pattern to be approved of by the local authority. His only objection to that was that it would probably give to the local authority undue control over matters on which they were not very well qualified to form a judgment. These boxes would be comparatively small, and it would not be wise to give a local authority power over them. Another and a more important matter was that of overhead wires. It was proposed that words should be inserted to the effect that an order was to confer no power to place wires overhead. If that were all he should not object, but he should strenuously object to the words going further. At the present moment he believed the company had in common with a good many other persons—such as telegraph and telephone companies—a common law right in this matter, and could put up overhead wires if they got the consent of owners and occupiers, carrying the wires at a sufficient height to take them from house to house. Such wires were carried in great numbers over streets in London. The Telephone Company, he believed, did all its business in that way, and they would strongly resist the insertion of words which would have the effect of controlling or limiting their present legal rights in that respect. But they were perfectly ready to have words inserted that the order should confer no such power. The following words had been agreed to already, and had been put into several Provisional Orders:—"Nothing in this order shall authorise the undertakers to place electric light wires above ground, along, or over, or across any street without the express consent of the local authority." To that extent the company did not object to the proposed amendment, but beyond that they would not go. Some other objections, Mr. Pember said, he would prefer to leave to the determination of the Board of Trade arbitrator, and after explaining the special reasons why the company sought to be somewhat exempted from the Building Act of 1855, he passed to the attitude of the City of London. They took the view that they were in an exceptional position—that, in fact, they had powers under their own Acts of Parliament which authorised them to grant the requisite facilities for electric light undertakings, and they declined to assent to any powers being given by way of provisional order which would affect the area of the City of London. Further, they said that they had elaborated a plan of their own under which they sought to have the City lighted by public tender. This plan the company considered open to very grave objection, and they did not think any electric lighting company that valued its own position would accept the terms which were offered by the City according to the form of tender they proposed. On another point they disagreed with the City. They contended that the City was not in the sense claimed outside the electric lighting Acts. There was a schedule to the Acts which defined local authorities, and among the local authorities there described he found the City of London and the liberties thereof defined as one. He therefore failed to see that the City was exempted from the purview of the Acts, but it would be for the Board of Trade to decide. Finally, Mr. Pember maintained that the dissent of a local authority could not be a veto, and that the Board of Trade had an undoubted right to grant the order now asked for, or any other order, against the wishes of a local authority.

THE EARL OF CRAWFORD and BALCARRES was called on behalf of the London Electric Supply Company, and examined by MR. LLOYD. In reply to that gentleman, the noble lord stated that he was a Past-President of the Institution of Electrical Engineers. He was Chief Commissioner in 1882 for Her Majesty's Government at the Paris Electrical Exhibition, and during the past ten years he had paid a great deal of attention to electric lighting, and electricity generally. He was now chairman of the undertakers of the London Electric Supply Corporation. This corporation was formed to take over the company formerly known as Sir Coutts Lindsay and Company, Limited. That was started in 1885, and the original directors of that company, when they found they had reached a point when they were unable to carry on the undertaking, resolved to make the company a larger one. The result was the present company, and the directors were the same. They had thus had a consecutive experience of five years. On the point of whether electricity could be best supplied from the midst of a populous area or from a distance, the directors soon after they commenced work came to the conclusion that it would be very much to their advantage if they could get a position away from a populous area. They commenced their operations in what might be called a cellar under the Grosvenor Gallery. They put down engines and generating plant to an extent which they believed would be sufficient to supply 25,000 lights from that centre, but in that confined space below ground they could not get ventilation as good as they might. There were many other objections insuperable to working machines there, such as smoke, vibration, noise, and general discomfort to the neighbours, which led them to think it would be highly desirable to get away to a part of the town either not a manufacturing district, or to a part quite free from neighbours who would object to such things. While they were at the Grosvenor Gallery they had to fight four actions for injunctions, which they had so far defeated. They had had altogether eleven threatened injunctions, some of which they had "squared;" others they had fought, and others again they were fighting. Some of the neighbours had stayed their hands on the assurance that the company were looking out for another place at a distance. He had watched the fate of other installations in populous neighbourhoods, and he believed both the Paddington and the Jermyn Street undertakers and others had been threatened in the same manner. He had come to the conclusion that there were many reasons why a large area could be worked better than a small one. As to the financial position of his company, their authorised capital was £1,250,000. Of that, £805,000 had been subscribed, and of that £536,300 had been paid up. Out of that amount they had still in hand £130,000, and they had at call £219,000. The sum actually expended when they had finished their present works would be £586,000. The sum of £130,000 was for contracts which had been given out, or for finishing the work they proposed to do. With their capital they would be able to supply as much light as houses were likely to require at first, but they did not contemplate having to supply the whole area at once. There must be a gradual progress, as people followed each other in adopting the light. The use of electricity as a motive power would, he believed, follow the lighting, and would in time throw the latter into the shade in importance. The works at Deptford had been arranged with a view to that gradual development, and in such a way that additions could be made without inconvenience. Practically at this moment their engines had a power of 20,000 H.P. Two engines had been running under steam during last week of 1,500 H.P., and another would be running this week with the same H.P. They were also putting up two machines (engine and dynamo combined) of which 5,000 H.P. would be put to each. At a later period, so as not to make the output too large at first, each of these machines would be doubled by another engine being put on. They would then have two engines with 10,000 H.P., and they hoped to have the first one ready in August next. With that amount of horse-power available each machine would give a current certainly for 100,000 10-candle lights. According to their experience of the smaller class of dynamos, they would probably give a current for 150,000 lights. That would give a total of 250,000 lights, but they would not supply the total at once, but would keep a large power in reserve for contingencies. With respect to electrical transmission with safety and convenience, Lord Crawford stated that the energy had been transmitted many miles. The system this company were using was first tested in 1883 at the Turin Exhibition, and the current was transmitted a distance of about 56 kilometres—or about 30 miles. But they proposed now to carry the current only about seven miles—from Deptford to Chelsea. There was no difficulty whatever in transmitting the current that distance with safety to life and property. As to the electricity itself there would be some loss through transmission, due to retardation in the copper, but on the system they were adopting, and the voltage, he did not think the loss would be sufficient to be considered. In reply to further questions, Lord Crawford spoke in confirmation of Mr. Pember's argument as to the removal of noise and other objections from a populous area, the economical advantages of being able to get coal direct, of having the works under one management, and other points of the same kind. With respect to multiplied undertakings in one area he expressed the opinion that although it was an advantage of course to a company to have no competition in the same district, it was a distinct advantage to the public to have more than one undertaker there. Considering the size of the mains, there would be no such inconvenience in the matter of disturbing streets as there would be in laying gas mains. There was no reason why two mains should not be placed in close proximity. His company were entirely opposed to monopoly, believing that to be contrary to the spirit of Parliament. They asked for no exclusive powers, but if it should be held that only one company should be allowed in one area, then they considered that their system was the best to be adopted.

In cross-examination by Mr. MOULTON, Lord Crawford said the company were bound to no system, but took that which they considered the best; but it did not necessarily follow that any other company could adopt any method which they might take. Some methods were protected by patents. The system they now proposed to adopt was the transformer system. They intended only to give out current for 150,000 lights, keeping an equal power in reserve. There were no capital clauses in this order similar to that in the Chelsea Act, and as to the question of being obliged to lay down mains, any business man would, of course, take the best parts of an area first. If a company failed to supply light when required to do so, someone else would be put in their place to do it. He had not gone into the details of the cost of thoroughly lighting all the streets in an area, but he would put it at 12s. 6d. a yard—1,100 miles at 12s. 6d. a yard. To state what the whole cost would be, he would require to be told how many lamps he had to supply. The largest installation under this system which had been in operation was that at the Grosvenor Gallery, where they supplied 30,000 lamps, but they had had great difficulties and some failures, owing to insuperable obstacles. The engines there nominally supplied a current for 10,000 10-C.P. lights each. That would require 500 H.P. All the lights were dependent on the correct working of the dynamo, and to guard against accident it was necessary to have a duplicate plant. The current proposed to be supplied would be carried into the houses at a pressure of 2,000 volts, but would then be transformed down to 100 volts. After some further questions by Mr. Moulton, Lord Crawford was cross-examined by Mr. Goldney, on behalf of the City of London, and the Court adjourned.

The enquiry being resumed on Thursday morning, Lord Crawford was subjected to further cross-examination at the hands of Mr. Goldney, on behalf of the Commissioners of Sewers, and several other representatives of companies and local authorities interested in the question.

(*To be continued.*)

Electricity and Bankruptcy.—At a meeting of his creditors, John Gilson, provision dealer of Sheffield, attributed his insolvency to ill-health, and expenditure on alterations and the installation of the electric light, which proved not to be a success. The Official Receiver, however, stated that the man had been about as reckless as he could be, and that it did not matter a fig to him whether his creditors lost their money or not. If he succeeded it was all right; if not, it would not be his loss, but his creditors'. Such downright recklessness ought to subject a man to prosecution. Mr. Howe, the debtor's solicitor, said it was the electric light which had brought him down. The Official Receiver: He ought not to have gone in for the electric light. The idea of it in a little shop in Ecclesall Road is absurd. The matter was left in the hands of the Official Receiver.

OBITUARY.

C. H. B. PATEY.

IT is with great regret that we record the death of Mr. Charles H. B. Patey, C.B., Secretary of the Postal Telegraphs, which occurred, after only a few days' illness, at his residence, South Lawn, Bickley, on Thursday last week. Mr. Patey was, a week before his demise, actively engaged in Paris in connection with the taking over by the British Government of the telegraphic service between England and the Continent, hitherto carried on by the Submarine Telegraph Company. On the Saturday prior to his decease inflammation of the lungs set in, and developed rapidly, death ensuing at 5 o'clock in the evening of the day named. The suddenness of the deceased gentleman's death caused a profound feeling of sadness and deepest regret among a very large number of friends in both social and official circles, and much sympathy is expressed for the widow and young children who mourn, indeed, a heavy loss. The funeral took place in Bromley Cemetery last Tuesday afternoon, at three o'clock. The *cortége* left Bickley shortly after 2.30 p.m., and at Widmore Road was joined by detachments of the 24th Middlesex Post Office Volunteers and Field Telegraph Corps, under the command of Major MacGregor and Captain Ogilvie, a detachment of the Royal Engineers, under the command of Captain Wood, the officers and men of the telegraph cable ship *Monarch*, and about a hundred letter carriers and telegraph messengers. The procession was met at the cemetery gates by the Rev. G. W. Weldon, vicar of Bickley, and the Rev. C. Patey, by whom the service was conducted, the former officiating in the little chapel, and the latter at the graveside. Around the grave gathered a large number of officers connected with the General Post Office. The principal mourners were Mrs. Patey, sen., Messrs. C. W. H. and E. Patey, Miss A. Patey, Mrs. Scott, Mr. Overbury, the Rev. — Scott, General Brendon, Mr. R. Morley, Captain Ching, R.N., the Rev. C. Patey, Mr. and Mrs. P. Fox, Miss Overbury, Miss R. Pearson, Mr. H. Pearson, Mr. J. Rowe, Dr. Mathews, sen., and Dr. Matthews. Among others whom we noticed with heads uncovered at the graveside, anxious to pay a last tribute of respect to the memory of their deceased comrade and friend, were the Right Hon. C. Raikes, M.P. (Postmaster-General), Sir Arthur Blackwood (Secretary of the Post Office), Major Tullock, Sir James Anderson, Mr. Barnes, Sir Reginald Welby (Permanent Secretary to the Treasury), Mr. N. R. Dyer, Mr. Hunter, Mr. Joyce, Mr. James Lamb, Mr. Graves, Mr. Fischer, Mr. Preece, Mr. Cardin, Mr. Ardron, Mr. Stevenson, and many others. Mr. Jackson, Financial Secretary to the Treasury, and Mr. Shaw Lefevre, late Postmaster-General, were prevented from attending by urgent public business. Mr. N. E. Baines, C.B., and Mr. Reay were at the railway station, but could not join the party from ill-health. Numerous and beautiful wreaths and crosses literally hid the coffin, and covered a large space on either side of the grave as well. The most noticeable was probably a magnificent wreath of Neapolitan violets, from Mr. Coulon, Director-General of Posts and Telegraphs, Paris, bearing the following inscription:—"A Pâtey, l'Administration des Télégraphes de France;" among the other beautiful wreaths and crosses were noticed "a token of regard and deepest sympathy from Sir Arthur Blackwood and the Duchess of Manchester."

Charles Henry Bennett Patey was a son of the late Admiral C. G. E. Patey, C.M.G. He entered the Post Office at the age of nineteen as a clerk in the secretary's office in the year 1863. Shortly afterwards Parliament sanctioned the working of telegraphs by the State, and throughout the ardous work which fell upon the Post Office for some years, in effecting the necessary purchases from telegraph and railway companies and in organising the new service, Mr. Patey rendered valuable assistance, and attracted the notice of his official superiors by the energy and ability with which he discharged his duties. In 1877 he was appointed

Assistant-Secretary to the Post Office, and in 1882 the late Mr. Fawcett promoted him to the post of Third Secretary. Thus during the last twelve years Mr. Patey has taken an active part in the management of the Post Office, the general superintendence of the telegraphic service being specially in his charge. There can be no doubt that the strain of work, which was always increasing, and in which he took an intense interest, told on Mr. Patey's strength. About five years ago he suffered from a very severe attack of inflammation of the lungs, and, although his recovery appeared to be complete, his constitution had probably been enfeebled. He was in his forty-fifth year, and leaves a widow and five sons.

We regret to learn of the death of Mr. Edward Cooper Warburton, M.S.T.E.&E., which occurred at Glenthorn, Horwich, Lancashire, on Saturday last. Deceased was in his 50th year. Mr. Warburton was formerly with Mr. Spagnoletti on the Great Western Railway, but has latterly been Superintendent of the Telegraph Department of the Lancashire and Yorkshire Railway.

NOTES.

The Electric Lighting of the Left Bank of the Seine.—The left bank of the Seine has hitherto been left out in the cold by the various electric lighting undertakings. This omission cropped up at the last meeting of the Paris Municipal Council, when M. Deville wished to know where the lighting of that portion of the city of Paris was. M. Alphand said he had received certain propositions which were under examination. M. Deville insisted, in his own name and those of his colleagues who represented the left bank, that a decision should be come to as quickly as possible. He then introduced the following proposition:—1. There shall be in the future no electric lighting concessions granted on the right bank unless the concessionaires undertake to also light a portion of the left bank. 2. The trials of electric lighting to be made by the city during the exhibition shall take place in part in the great thoroughfares of the left bank. After several councillors had spoken *pro* and *con.*, M. Deville's proposition was adopted. The Council afterwards forwarding to the Budget Commission a request for a credit of 50,000 francs for electric lighting trials on the left bank of the river.

Electricity v. Gas at Chelmsford.—The question whether gas is to be superseded by electricity for lighting the public streets of Chelmsford has arrived at a crucial stage. The Lighting Committee of the Town Council, at a meeting held on February 25th, having had under consideration tenders for lighting by means of oil, gas, and electricity, reported in favour of the last named, recommending "The Council to enter into a contract for lighting the borough for five years with Messrs. Crompton & Co., Limited, upon the terms of their amended tender, dated February 13th, provided that the term for which they retain the right of private lighting be reduced to five years from the expiration of the contract, and subject to the details of the contract being approved by the Lighting Committee." Messrs. Crompton propose to replace 78 of the present gas lamps by 20 arc lamps, and to substitute for 110 other gas lamps 72 incandescent lamps and 38 oil lamps (these last in the outlying districts), at a cost of £700 per annum. The tender of the Gas Company was £3 14s. per lamp per annum, as against £4 5s. 6d. for last year, showing a reduction of about £100; and, taking the number of lamps as 188, the yearly cost would be £695 12s. The full Council have had the report before them on two occasions, and, at a special meeting held a fortnight ago, it was decided to call a public meeting, and invite the opinion of the burgesses upon the matter. This meeting took place in the Corn Exchange on Tuesday evening, the 26th ult., and the packed attendance showed that very great interest is felt in the subject. The Mayor (Mr. F. Chancellor) presided, and every member of the Council was present. The question in all its aspects having been lucidly explained by the chairman, Mr. Councillor Whitmore, who was received with hearty applause, moved, "That this meeting is of opinion that the recommendation of the Lighting Committee be carried out, namely, that the Council be requested to accept the tender of Messrs. Crompton & Co. for the public lighting of the borough." He stated that arc lamps would be used from the Red Cow as far as the Cricketers in Moulsham, and about the same distance up the New London Road, the whole of the remaining part of the town to be lighted by incandescent lamps. The arc lamps would be of 1,200 candle-power, and the incandescent lamps of 32 candle-power, as against the present gas lamps of about 12½ to 15 candle-power. He believed the adoption of the scheme would improve the trade of the town, and he was satisfied it would generally improve the appearance of the borough. Mr. Councillor Darby cordially seconded the proposition. The Chairman, replying to questions, said he thought possibly the vote of that meeting might have weight, but whether it was to be taken as conclusive must be left with each individual Councillor to say what importance he attached to the vote. Mr. Cutts moved an amendment in favour of lighting the main streets with arc lamps and the other parts of the town with gas. This was not seconded. Mr. Alderman Duffield, chairman of the gas company, said the gas company had sent in an amended tender, offering to light all the present lamps for the sum of £604, which was something like £100 in expense below the tender of Messrs. Crompton & Co. He was not, however, going to put the question purely as one of expense; the question was which was the best, and which they could rely upon most, in the present state of matters. He went on to assert that the electric light for public purposes had been proved to be almost an entire failure. Mr. Alderman Brown, the chairman of the Lighting Committee, having replied to the remarks of Mr. Cutts and Mr. Duffield, Mr. Councillor Whitmore's proposition was put and carried by a very large majority, and the proceedings, which were at times extremely lively, concluded with a vote of thanks to the Mayor for presiding.

Westminster and the Electric Light.—At a meeting of the vestry of St. Margaret's and St. John's (Westminster), on Wednesday last week, the Parliamentary Committee reported that they had caused an inquiry to be made of all the lighting authorities in the kingdom in whose districts the electric light was known to be in use, and submitted a summary of the replies received. Of the twenty-eight authorities to whom such application was made, eighteen replied in satisfactory terms, while no answers were received from the remaining ten. The committee had further considered the question of electric lighting as it affected this district, together with the four applications for provisional orders, and the application for a licence now before the Board of Trade. They had also had before them numerous communications from the promotors and others, including a notice from the Board of Trade to the effect that Major Marindin had been appointed to hold an inquiry under the Electric Lighting Acts, for the purpose of reporting upon the various applications. Having regard to the objections already lodged on behalf of the Vestry, and to all the circumstances, the committee had resolved to defer, until the result of the Board of Trade inquiry was known, the presentation of any definite recommendation. They had, however, requested Mr. J. B. Batten, Mr. Thomas Horn, and Mr. J. K. Aston to attend the inquiry on behalf of the Vestry, and recommended that those gentlemen should have authority to call in counsel, Parliamentary agents, or the solicitor, as they might deem necessary. The report and recommendation were unanimously adopted.

Central Station at Zwolle.—Mr. Jurrian Stroink has opened a little central station for electric lighting in the town of Zwolle. The installation comprises an 8 H.P. engine, a dynamo giving 65 volts and 70 ampères, and a storage battery of 600 ampère hours. The number of lamps is 70. The engine runs for three or four days a week only. The battery is charged one day, and the next serves to run the lamps. An Aron meter is placed in the house of each consumer.

Electric Lighting at Norwich Free Library.—At a meeting of the Norwich Town Council last Friday, Mr. Green moved, on the recommendation of the Libraries Committee, that the estimate of Messrs. Laurence, Paris and Scott, Limited, to place electric light wires and fittings in the ground and reading room floors of the free library for the sum of £90, and to supply electric light according to the specification at the sum of £80 per annum, be accepted and that a contract be prepared, and the corporate seal affixed. He said the contemplated expenditure had accrued through the unfortunate breaking down of the gas lighting appliances in the institution. Mr. Squirrel seconded, saying he did not think the extra money would prove a real increase. The Mayor having remarked that electric lighting should receive the greatest possible encouragement, the motion was passed.

Electric Lighting at Colchester.—The extensive system of electric lighting recently established in the steam flour mills of Messrs Edward Marriage & Son, Colchester, was on Thursday formally inaugurated in the presence of the Mayor (Mr. E. J. Sanders) and other gentlemen interested in the development of various industries in the Borough. The mill is lighted by 120 16-C.P. incandescent lamps within, and outside is brilliant with the light afforded by four powerful arcs.

Church Lighting at Halifax.—In alluding to the lighting of Square Church, Halifax, by electricity, last week, we omitted to state that the installation was carried out by Messrs. Blakey, Emmott & Co., who have lately had a great deal of lighting work to do in the heart of Halifax, where there is, taking the size of the town into account, more electric lighting to be seen than in any other part of the United Kingdom at this moment.

Ship Lighting.—Messrs. W. H. Allen & Co., of York Street Works, Lambeth, have just completed the lighting of a large passenger vessel, built by Messrs. Laird Brothers, Birkenhead, for the Compania sud Americana de Vapores. The vessel, named the *Imperial*, is one of 2,000 tons burthen, and the electric light has been provided for every part of the ship, from the mast head to the coal bunkers, over 230 glow lamps of the Edison-Swan type being used. The signal lights are considerably stronger than can be provided by the best oil lamps, and are so fitted that oil can be substituted, if needful, at a moment's notice. Special brackets are supplied for loading purposes. In the engine room, bunkers, and holds, plugs have been inserted so that the current may be tapped, and a powerful light concentrated in any given spot for temporary purposes. The elegant electroliers for the saloon and social hall have been designed to suit the fittings and furniture, and are adapted both for oil and electricity. The lamps exposed to rough usage are enclosed by damp proof bell glasses, and these are protected by strong wire cages. Cockburn's slate switches and fuse boxes have been plentifully used throughout, each state room being separately connected. The conductors branch into six circuits from a six-way slate switchboard, and a second board with the main fuses and fitted with a voltmeter, is placed on the return circuit. All the wires are enclosed in wood casings. The "Kapp" dynamo is compound wound, and capable of feeding the whole of the lamps at the low speed of 280 revolutions per minute. It is driven direct by an Allen twin engine at a steam pressure of 160 pounds. The engine and dynamo are so fitted as to work without vibration, and no sparks are visible at the brushes. The installation has been superintended throughout by Messrs. Allen's electrician, Mr. J. W. Kempster, and gave universal satisfaction on the trial.

Telegraphs in Remote Regions.—The exigencies of life are such that even in the most out-of-the-way parts of the globe the telegraph wire is to be found, winding its course through well-nigh inaccessible regions, far removed from all but the veriest suggestion of civilisation. For example, the British Consul in Colombia, who resides at Bogota, the only road to which is described as consisting of "a series of rocky staircases and quagmires, which in the rainy season are dangerous, and in some parts so narrow that two mules cannot pass each other," states that even in this country "there are at present some 2,800 miles of telegraph in working order, and about 200 miles more in course of construction." To indicate more clearly the conditions under which this work is carried out, it is only necessary to add that the country which many of the lines pass is so wild and desolate that it is very difficult to keep the lines in order, and the line to Buenaventura, on the Pacific, which connects Bogota with Panama and the European cables, has to cross one of the most difficult passes in the whole country, viz., the Quindio Pass across the Central Condillera, at a height of over 11,000 feet, traversing an almost uninhabited region of forests and precipices for a distance involving five days' travelling. The electricians out there are not to be envied, nor have they much to be thankful for.

The Telephone Amalgamation.—According to the *Financial News*, the negotiations for the amalgamation of the three chief telephone companies have now arrived at a point when it is almost certain that they will be satisfactorily concluded. The strength of the market for telephone shares is owing to this fact, and also that the present managing director of the United Telephone Company, Mr. J. B. Morgan, is to have no part—beyond, possibly, a seat on the Board—in the management of the amalgamated company. Of this latter outcome of the arrangements the market highly approves, as it considers that at last a satisfactory telephone system in London will be possible.

Architectural and Building Trades Exhibition.—Electric lighting does not seem to make much headway at the exhibitions periodically held at the Agricultural Hall, Islington, and at the Builders' Exhibition, which opened on the 1st, and closes on the 13th, there is perhaps even less than there has been on former occasions. There are, however, two good electrical exhibits, that of Messrs. Verity Bros., which includes some fine specimens of work in hammered iron, and that of the proprietors of the Acme Electric Works, which comprises a great variety of Cockburn switches, cut-outs, bell pushes, china and glass ware, measuring instruments (Ayrton and Perry's), and a number of other electrical requirements.

The Electro-Harmonic Society.—The fifth concert of this season took place on Friday evening last, Mr. R. Kaye Gray presiding, and was quite as numerously attended as any that had preceded it. With such well known names in electrical circles as those of several who contributed to the programme, an interesting concert was only to be expected. Where all did their best it would perhaps be invidious to criticise, even if we were so disposed; but we may with confidence say that the singing was very good, much of the instrumental music equally so, whilst the humourous contributions were undoubtedly appreciated (as evidenced by the encores) in the fullest degree. With zither duets, banjo trios, and musical sketches, the latter rendered by one who kindly filled a gap in the programme caused by illness, a most enjoyable evening was spent, and without hitch or the slightest flagging of spirit, brought to a successful termination.

Burning Arc Lamps in Parallel.—A correspondent writes :—"I have lately noticed several installations in which arc lamps have been burning in parallel from compound-wound dynamos. In every instance there has been a resistance in each branch, presumably because the lamps will not burn well without it. This must mean a great waste of power. I should be glad to know if there are any arc lamps in the market which do not require such a device—*i.e.*, that will burn steadily and with normal current when supplied with a constant P.D. at their terminals."

Standardising Electrical Apparatus. — The new electrical standardising laboratory erected in Berlin, under Government auspices, is now open for the testing and calibrating of electrical appliances. The arrangements for ensuring to a purchaser that the instrument he purchases has passed the prescribed test appears to be certain, and the prices charged by the *bureau* to manufacturers or others who wish their apparatus overhauled appear moderate.

A Book to Read. — "The Economic Value of Electric Light and Power" is the title of a book by A. R. Foote, of Cincinnati. We learn from an American exchange that the subject is taken hold of and presented to the public from a commercial standpoint, and the book is recommended, not to capitalists alone, but to all connected with electric light and power enterprises. The changes which have occurred in electric lighting plant since 1883 are very remarkable, and compared with the prices now existing in the States, the following information has been compiled :—

Dynamos	Increased efficiency	25	per cent.
	Decreased cost	40	„
Incandescent Lamps.	Increased efficiency ...	100	„
	„ life	100	„
	Decreased cost	66	„
Carbons, Decreased cost		75	„
Wire, „		20	„
Line Construction, „		20	„

Series or Parallel.—Mr. Wilfrid L. Spence, in the correspondence columns of the *Engineer*, challenges the statements recently put forth by the Series Electrical Traction Syndicate respecting the loss in working when compared with the parallel system. It will be remembered that we fought shy of certain figures which we believed to be of American origin, but Mr. Spence goes further, and demolishes them. With regard to the assertion that only 5 horse-power is lost on the series plan when transmitting 400 horse-power useful, this gentleman calculates that this small waste can only be secured by using a conductor nearly as large as that required in parallel working, with an electromotive force of 6,000 volts. Under these alarming circumstances it is scarcely to be wondered at that Mr. Spence draws a mournful picture of the compensation to be doled out to widows and children of late car-drivers and line-men.

Mechanical Units.—The discussion on Prof. Kennedy's paper on the Society of Arts motor trials gave Mr. Preece the not unwelcome opportunity of making an onslaught against what he designates the abominable unit termed horse-power, for which, as is well known, he wishes to substitute the watt as a representative of the mechanical unit of power. He anticipates the pleasure of living to see the watt adopted by all engineers. We have our fears that he will be doomed to disappointment, unless, indeed, he is to rival the age of the patriarch, and even in that event it is not improbable that Mr. Preece's love, the watt, will share the fate of that beauty so touchingly described by a lover in the "Loves of the Antediluvians," when the lover exclaims "What is beauty? It is like the oak which flourishes for a few centuries and then decays." Imagine the impact of a shell from a 120 ton gun being reckoned in watts! It would be, as some one has previously remarked, like summing up our National debt in continental small change.

Royal Society.—At Thursday's meeting papers were read by Prof. Thorpe, F.R.S., "On the Magnetic Inclination, Force, and Declination in the Caribee Islands, West Indies," and by Captain Sankey on "Experiments on the Resistance of Electrolytic Cells."

"Electric Railroads."—A volume with this title is shortly to be brought out in the States by Mr. F. H. Whipple. There is ample material for an interesting volume, and from rumours which have reached us we have reason to think that purchasers of Mr. Whipple's book will not be disappointed.

City and Guilds of London Institute Old Students' Association.—The second number of the Journal of this Association has been issued, and contains, besides other matter, Mr. Helter's paper on "Aluminium," and Mr. Albion T. Snell's paper on "Electromotors;" in consequence of the rapid sale of this number a reprint has been necessary. Copies may now be obtained, price 7d. each (postage included).

Gordon Technical College, Geelong.—This institution, erected as a memorial to the late General Gordon, was opened in November, 1887, and the first annual report of the President and Council has been issued. There are about a dozen classes, and all seem well attended. With regard to the class for telegraphy, the report says :—"Mr. J. A. Dawson reports that the attendance has been very good. The theory and practice of telegraphy and the electric currents have been fully demonstrated, and good results have been obtained. Many of the students come from the country districts, taking advantage of the liberal reductions made by the railway department to students attending the college."

Institution of Electrical Engineers.—On Thursday, 11th inst., the following paper will be read "On Underground Conduits and Electrical Conductors," by John B. Verity, Member.

A Deal in Electric Sugar.—At the Birmingham Assizes on Tuesday, before Baron Pollock, John James Bishop, of Birmingham, brought an action against William Doubleday, architect, Colmore Row, to recover £82, being the value at the time of its sale of a share in the since exploded Electric Sugar Company. It appeared that some time in December last, when the company's £20 shares were quoted at £81, defendant bought four shares from Mr. Dorricott, and at the same time agreed to purchase a fifth for £82, which latter was to come into the January 10th account. This was before the burst up of the concern. The shares were obtained by Mr. Dorricott for the plaintiff, and after the exposure the former made a written assignment to Mr. Bishop of the debt due to him from the plaintiff in respect of this particular share, viz., £82. Defendant refused to pay the amount, and part of the defence now set up was that there never was such a company as the Electric Sugar Refining Company, or that it ever was legally formed. His Lordship gave judgment for the plaintiff with costs.

The Edison Exhibit in Paris.—This is the way the New York *Tribune* puts it : "So Mr. Edison is to have 8,000 square feet of space in the Paris Exposition solely for the display of the more important of his own works. Is there a parallel to this in the annals of invention? This ex-newsboy is the eighth wonder of the world, and you are respectfully requested not to forget it."

Electric Tramways in Spain.—Some time ago a petition was lodged with the Madrid municipality to obtain powers to erect a tramway, about two miles long, in the north of the city. It was pointed out in the technical papers a few weeks ago, says *Industries*, that it was undesirable that any more concessions should be granted for tramways in Madrid, unless electricity were used as the motive power. The persons interested have now offered to employ electricity, and a decision may soon be expected. All the tramway lines in Madrid start from one point, La Puerta del Sol, and in consequence a great block often takes place.

Execution by Electricity.—The same discussion that took place in New York by the Medico-Legal Society, regarding death by electricity, is now going on in Chicago. The Chicago Medico-Legal Society held a meeting to discuss the subject, and their views were very inimical to the general adoption of the project. This agitation is called up largely because a bill has been introduced into the Illinois Legislature which has the same import as the one recently carried in New York. Eight physicians spoke on the subject, and of this number there were but two who approved it in any way. The feeling was decidedly in favour of continuing the present method of capital punishment—that of hanging. On the ground of humanity, it was claimed that the amount of suffering the criminal endures is greatly over-estimated. More than one physician there endorsed the statement that after the noose tightened there was no further consciousness, and the subsequent twitching of the muscles was simply nervous. It was argued that electricity was a youthful science, and it would injure it from a commercial standpoint to make of it an agent for capital punishment. A copy of the minutes of this meeting is to be sent to the legislature.

NEW COMPANIES REGISTERED.

Halifax Mutual Electric Light and Power Company, Limited.—Capital £20,000, in £5 shares. Objects: To produce and supply electric currents or force for light heat, motive power, or for means of communication, and generally to carry on business as electrical engineers, manufacturers, and contractors. Signatories (with 1 share each): *F. H. Bowman, *J. Asquith, A. Fletcher, G. A. Blackburn, R. Needham, all of Halifax; *J. Haley, Cleckheaton; T. Brown, Hipperholme. The signatures are witnessed by George Linz (electrical engineer), of 16, Gladstone Street, Bradford. The signatories denoted by an asterisk are the first directors, and their remuneration will be determined by the company in general meeting. Registered 27th ult. by C. Doubble, registration agent, 14, Serjeants' Inn, Fleet Street.

Dermatine Company, Limited.—Capital £55,000, in £5 shares. Objects: To take over the business of the British and Colonial Dermatine Company, Limited, a company formed on May 8th, 1886, to manufacture an improved substitute for gutta-percha for insulating, waterproofing, and other purposes. Signatories (with 1 share each): *Thos. Fermelly, Broad Street; *A. Le Neve Foster, 61, Cadogan Square, S.W.; *J. F. R. Brewer, 41, Threadneedle Street: Sir H. C. Mance, Bedford; John Cooper, Herring Street, Camberwell; E. Boden, 1, Sandover Road, Camberwell; Wm. Burn, 13, Moorgate Street. Directors' qualification, £250 of the nominal capital. The signatories denoted by an asterisk and Charles Kuypers are the first directors, remuneration—an amount equal to £100 in respect of each director. Registered 29th ult. by Crosley and Burn, 13, Moorgate Street.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Pacific Telegraph Company, Limited.—The annual return of this company is made up to the 14th January. The nominal capital is £2,000,000, in £10 shares. 18 shares have been taken up, and the full amount has been called thereon. The calls paid amount to £120, leaving £60 unpaid. Registered office, 34, Clement's Lane, E.C.

British and Colonial Dermatine Company, Limited.—At a special general meeting held on the 13th ult. at Winchester House, it was resolved to wind up voluntarily, and to appoint Messrs. Arthur Le Neve Foster, Thos. Fermelly, F. J. R. Brewer, and Charles Kuypers, as joint liquidators, with power to sell the property of the company to a new company upon the following terms:—8,681 shares in the new company, credited with £4 7s. 6d. as paid up, leaving a liability of 12s. 6d. per share, and the payment and satisfaction of the debts and liabilities of this company, and the costs of winding up. The resolutions were confirmed at a meeting held on the 28th ult., and were duly filed on the following day.

Windsor and Eton Electric Light Company, Limited.—The statutory return of this company, made up to the 28th ult., was filed on the same day. The nominal capital is £30,000, divided into 5,950 shares of £5 each, and 250 founders' shares of £1 each. 210 ordinary shares have been taken up, and the full amount has been called upon 7 of these, and £1 per share upon 203 shares. The calls paid amount to £238. Registered office, Acre House, Windsor.

Chelsea Electricity Supply Company, Limited.—An agreement of 21st inst. between this company and the Electrical Power Storage Company, Limited, cites that on the 18th February, 1889, an order was given by the Chelsea Company to the Storage Company to proceed with work of the approximate cost of £7,247, and in accordance with the provisions of previous agreements, the Chelsea Company have exercised their option to pay 25 per cent. thereof in fully paid up ordinary shares, reserving the right to pay all or part of the amount payable ordinary shares.

Buckingham Electric Light and Power Supply Company, Limited.—The registered office of this company is now situate at Hunter Street, Prebend End, Buckingham.

LEGAL.

In re the Midlands Electric Light and Power Company, Limited.—This was a motion under section 35 of the Companies' Act, 1862, to rectify the register of shares of a company by striking out the name of Mr. Arthur Chamberlain, of Birmingham, as holder of 2,074 £10 ordinary shares, on the ground that they had been issued at a discount, and, therefore, under an *ultra vires* contract. The question raised was whether the contract under which the shares were issued really was a contract to issue those shares at a discount, or to issue them in consideration of a debt of the amount of the nominal value of the shares. An agreement was entered into, dated April, 1887, between Mr. Arthur Chamberlain and the company which provided for the sale of certain concessions to the company. The agreement also provided for advances being made by Mr. Arthur Chamberlain on account of the company, payable on demand by the company to Mr. Chamberlain, with interest at the rate of 15 per cent. per annum from the dates of the advances, with an alternative that Mr. Chamberlain should have the option of taking shares, to be paid for by the advances without interest, but with the addition of 15 per cent. on the money advanced. The amount advanced to the company by Mr. Chamberlain to the end of 1887 was found to be £18,041 5s. 11d. and £2,706 3s. 9d., or 15 per cent. added to that sum brought the amount for which Mr. Camberlain was to have the option of receiving shares up to the aggregate sum of £20,747 9s. 8d. A second agreement was made between the parties in April, 1888, which recited that Mr. Chamberlain had elected to accept, in satisfaction of £20,740, part of the aggregate sum, 2,070 fully paid-up shares, leaving a balance due to him of £7 9s. 8d., and provided that, as soon as that agreement should be registered, that number of shares should be issued to him. That agreement was registered, and the shares issued to Mr. Chamberlain, on whose behalf this motion was made to determine whether the transaction was legal. It was clear that a year's interest was not due on the whole of the advances, so that £2,706 3s. 9d. was more than interest at 15 per cent. per annum. Mr. Birrell appeared for Mr. Arthur Chamberlain. Mr. R. J. Parker, for the company, submitted that the whole agreement of April, 1887, was to be taken together, and the sum of £20,747 9s. 8d. was, therefore, a debt due partly for advances and partly for purchase money; and the shares were therefore issued for an equivalent debt equal to their nominal value. Mr. Justice North considered this argument more ingenious than sound, for the parties by their agreement had shown that the transactions were distinct, and had themselves severed them. The nominal purchase money, he said, was more than the advances and interest. The shares were, therefore, issued at a discount, and it followed that the contract to issue them was void.

CITY NOTES, REPORTS, MEETINGS, &c.

Electrical Power Storage Company, Limited.

The report of the directors states that the gross profit for the year is £13,273 15s. 3d., which includes all royalties and receipts, the bulk of this profit being derived from the manufacture of storage batteries, and special apparatus in connection therewith.

The expenditure for the year, including debenture and other interest, &c., is £11,709 3s. 8d., and the balance added to the amount standing to the credit of profit and loss makes the sum of £3,372 13s. 6d., out of which the directors would recommend a dividend were it not that the increasing volume of business demands a larger working capital, and the best method of securing this has been, and is, a subject of anxious consideration by the directors.

During the year under review there was a considerable increase in the company's business, while, as compared with the corresponding period of the year 1888, the orders received this year up to date have already nearly doubled.

To meet this rapid growth of business, it has been necessary to make a considerable outlay on the Millwall Works, and to increase the staff. This additional outlay amounts to £1,827 3s. 6d.

The directors are glad to state that the company is not engaged in any litigation.

Among the many new electric light installations employing storage batteries may be mentioned the Lyric Theatre, where a 1,000 16-candle-power E.P.S. battery is erected; the London Joint Stock Bank; the private residences of Sir Henry Meux., Bart.; Mr. J. Fletcher Moulton, Q.C.; Mr. Alfred de Rothschild; Dr. John Hopkinson, F.R.S.; and the Royal Arsenal, Woolwich.

The new form of battery, known as the "1888" type, continues to give satisfaction.

A number of scientific and technical institutions have adopted accumulators, viz., the Central Guilds of London Institute, Millard Laboratory, Oxford; Cavendish Laboratory, Cambridge; University College of Wales, Cardiff; Heriot-Watt College, Edinburgh; Queen's College, Cork; and the University of Japan, Tokio.

A gold medal was awarded the company at the Brussels Exhibition for their exhibit of storage batteries and accessory apparatus.

Central station lighting, which the directors have regarded as ultimately the main source for the use on a commercial scale of storage batteries, is at last beginning to attract the serious attention of the public, and it is hoped that many of the applications for Provisional Orders now before the Board of Trade may be granted and confirmed by Parliament during the current year, as, until that result is attained, the full effect of the alteration of the law by the Electric Lighting Amendment Act of 1888 cannot be felt. The only company in the metropolis which possesses the requisite Parliamentary powers is the Chelsea Electricity Supply Company, under 50 Vic., cap. xviii., with which company a contract has been made for the supply of a large accumulator battery for its central station and sub-stations; the Chelsea Company will work its central station on the distribution system of the E.P.S. Company, and will supply light during the present month.

Batteries have also been furnished for central stations in various parts of the kingdom.

Accumulators for train lighting have been in demand. Extensions have been made to the lighting plant of the London Brighton and South Coast and Great Northern Railways, and batteries for this purpose have also been furnished to the Midland, London and North Western, and Taff Vale Railways, and South Western Railway of Russia.

For ship and yacht lighting a new type of accumulator has been designed, and has been supplied to the British Navy, the Italian and Danish Navies, and to yachts, among which may be mentioned the *Mohican*, *Wanderer*, and *Torfrida*.

The lighting of 40 omnibuses of the London General Omnibus Company is carried out by means of E.P.S. accumulators.

In surgical batteries a new use for accumulators has been found, and a portable type battery has been made from which current is supplied to cauteries, induction coils, motors and lamps, and to give special facility for recharging in London, Messrs. Coxeter and Sons, the surgical instrument makers, have established a charging station in Grafton Street, W.C.

For the propulsion of electric tramcars a large order has been received from the Electic Traction Company for storage batteries for six cars for working on the Barking line. An interesting experiment has also been made by Mr. Sandwell in propelling tramcars by batteries carried on a separate truck or bogie.

In electric launches, worked from storage batteries, progress has been made, as E.P.S. batteries are used in the *Maldon* and the *Viscountess Bury*, the latter a boat 65 feet long by 10 feet beam.

E.P.S. accumulators are also employed by Mr. Radcliffe Ward in his method of propelling vehicles on ordinary roads by electricity.

Throughout Europe the advantages of the use of storage batteries are gradually being realised, but several causes have tended to delay their general adoption. This year the directors hope the amount of royalties will be substantially increased, as the various companies and firms with whom arrangements have been made to manufacture E.P.S. batteries under royalty, have completed the erection of their factories. These are to supply the batteries in Germany, Austria, Hungary, France, Russia, Finland, and the Scandinavian countries.

The Electrical Accumulator Company of New York is pushing the business vigorously in all directions on the American Continent, and a pamphlet published by that company, showing how successful it has been in establishing its patent rights in the United States, will be read by the shareholders with much interest.

Liverpool Electric Supply Company, Limited.

The sixth annual meeting of the shareholders of this company was held in the Law Association Rooms, Cook Street, Liverpool, on Tuesday, Mr. A. H. Holme presiding.

In presenting their sixth annual statement, the directors reported a considerable extension of the company's business during the past 12 months, and the accounts showed the amount of net profit available for dividend, including the balance brought forward from 1887, to be £1,788 0s. 3d. Out of this sum the directors recommended the payment of a dividend of 3 per cent., absorbing £1,067. The capital expenditure during the year on land, buildings, and plant, including a proportionate charge for general expenses, amounted to £20,919 16s. 4d. The greater part of these additions could not be brought into remunerative working condition during the year, but the effect on the earnings of the company might be judged from the fact that the amount received for the supply of electricity during January, 1889, exceeded by about 20 per cent. the average monthly receipts for last November and December, and amounted to nearly four times the revenue derived from this source in January, 1888. In the month of June the Board of Trade issued to the company a licence authorising them to supply electricity by means of underground mains throughout certain portions of the city, and the directors had opened negotiations with the local authority with the view of obtaining for the company a Provisional Order, so as to secure the advantages afforded by the amended Electric Lighting Act of 1888. They confidently hoped that in the interests of the public, as well as the company, these negotiations might be brought to a successful issue. The total number of incandescent lamps now in connection with the company's system is three times greater than at the commencement of last year. The directors had secured a suitable site in Highfield Street for the extension of the company's most important station. Negotiations had also been completed for the purchase of a very favourable site for a central station for the Lime Street and residential districts of the city. The company had in hand numerous orders for electric fittings, and had secured the contract for the electric lighting of two new steamers now building for the White Star line.

The Chairman, in proposing the adoption of the report, said the company were proceeding with the underground mains as they were required by customers. Bold Street had been omitted from the area of licence, but the company were in negotiation with the Watch Committee in order to have the supply extended to that thoroughfare, and also to take advantage of the new Act of 1888. In their negotiations with the Watch Committee he had no doubt they would succeed. The position of the company as a dividend paying concern they knew. The initial expenditure was necessarily very large, but their receipts were increasing, and the directors had written off a large sum for depreciation. To provide for the expenditure on underground mains and three new stations, they would have to call up the remainder of the share capital.

Sir James Picton seconded the motion, and the report was adopted unanimously. Messrs. A. H. Holme and J. S. H. Banner were re-elected directors, and Mr. W. Jackson auditor. It was resolved that the next meeting of the company be held on or before the first week of March next. A vote of thanks to the chairman was passed, as customary.

The Eastern Extension, Australasia and China Telegraph Company, Limited.

The report and accounts of the directors for the half year ended December 31st, 1888, states that the gross receipts, including Government subsidies, have amounted during that period to £238,854 14s. 4d. against £232,660 0s. 11d. for the corresponding half year of 1887.

The working and other expenses, including £23,883 2s. 7d. for cost of repairs to cables and expenses of ships, absorb £71,519 7s. 4d. against £69,570 16s. 5d. for the corresponding period of 1887, leaving a balance of £167,335 7s. From this is deducted £3,049 15s. for income tax, £41,595 for interest on debentures and contributions to sinking funds, and £4,492 7s. 11d. for rebuilding staff quarters at Cape St. James, leaving £118,198 4s. 1d. as the net profit for the half year, which, with £47,903 4s. 1d. brought forward from the previous half year, shows an available balance of £166,101 8s. 2d.

One quarterly interim dividend of 1¼ per cent. has been paid for the half year, and it is now proposed to distribute another of like amount, making, with the interim dividends paid for the first half year, a total dividend of 5 per cent. It is also proposed to pay a bonus of 3s. per share, or 1½ per cent., making a total distribution of 6½ per cent. for the year 1888. The balance of £66,101 8s. 2d. has been carried to the general reserve fund, which, after being credited with the interest on investments received during the half year, and debited with the cost of the partial renewals of the Java-Australian cables off the Lombok Straits amounting to £18,986 19s. 5d. now stands at £690,454 18s. 4d.

In pursuance of the conditions upon which the issue was made, 119 of the company's 5 per cent. debentures of 1880 were drawn by lot on the 11th ultimo, for payment at par on the 1st May proximo. 291 of the company's five per cent. Australian Government subsidy debentures were also drawn on the 1st instant for payment at par on the 1st July next. The numbers of the drawn debentures will be found on pages 12 and 13.

The company's maintenance ships have been employed on various repairs during the half year under review, as shown in Abstract C, but no interruptions of a serious nature have taken place beyond those on the Australian section referred to in the last report, and subsequently for a few days whilst carrying out the renewals off the Lombok Straits. All the company's cables are now in good working order.

Since the close of the half year telegraphic communication with the Australasian colonies has been greatly strengthened by the extension of the company's system from Java to Western Australia. This extension, as explained in the last report, gives the colonies a third cable to Java, and brings into use the Western Australian land lines as an alternative system to the South Australian Overland line, thus minimising the risk of interruptions in the future.

The directors report that an agreement has been recently concluded with the Government of Tasmania by which the company's exclusive privilege of telegraphic communication between Tasmania and Victoria, which by effluxion of time would expire next year, has been extended for a further term of 20 years. The subsidy of £4,200 per annum, payable to the company by the Government, will be continued for the same period.

The Oriental Telephone Company, Limited.

THE report of the directors for the year ending December 31st, 1888, states that the revenue account shows a balance at credit of £6,651 12s. 8d., which has been transferred to profit and loss. Including the sum of £3,602 16s. 1d. brought forward from the previous year, the amount available for disposal is £10,254 8s. 9d., which the directors recommend should be dealt with as follows:—To place £2,500 to a reserve fund; to apply £3,000 in final extinction of preliminary expenses; to write off £341 4s. 8d. for depreciation of stores and balance cost of reconstruction of the Rangoon Exchange, and to pay a dividend of 3 per cent., free of income tax, on the paid up capital of the company, other than the vendors' shares, carrying forward £685 18s. 11d.

The directors consider that until some satisfactory arrangement has been come to with the holders of the vendors' shares, the soundest policy is to pay small dividends and to build up a reserve fund sufficient to meet whatever contingencies may happen.

The amounts received and to be received from the Indian companies for dividends for the past year on the shares held by this company, and which have been brought into the revenue account, include £150 belonging to 1887; and a small surplus arising on final settlement of the guarantee to the Bengal Telephone Company. The returns from the Indian companies show a moderate improvement, but the business in India generally is heavily weighted by Government and local taxes; and the continued restrictive policy of the Indian Telegraph Department acts detrimentally. An alteration in the management of the Bengal Company, carried out by your directors, has effected considerable saving in the working expenses of that company.

The Telephone Company of Egypt maintains its revenue, and has declared a dividend of 6 per cent. for the past year, free of income tax, carrying forward a sum of £1,069 14s. 11d. The directors of that company have placed £5,000 of debentures in Egypt, bearing interest at 6 per cent., and were thereby enabled to pay off the loan due to this company. At Rangoon and Singapore the branches are making satisfactory progress, but at Madras, Colombo and Mauritius the revenues remain stationary. The China and Japan Company's accounts for the past year exhibit a small surplus after paying debenture interest.

The question of the company's rights in the Australasian Colonies has been settled by an agreement being come to with the Western Electric Company of Chicago, whereby that company has undertaken to pay certain royalties. A payment has already been received in respect of these royalties, which has been applied in part reduction of the outlay incurred.

The retiring directors are Mr. Henry Gröwing and Mr. Thomas Lloyd, both of whom being eligible offer themselves for re-election. Messrs. Deloitte, Dever, Griffiths & Co., the auditors of the company, retire, but offer themselves for re-election.

Western Counties and South Wales Telephone Company, Limited.

THE fourth annual meeting of the shareholders was held on Wednesday, the 27th ult., at the Grand Hotel, Bristol, under the presidency of Mr. Charles Nash.

The Chairman, in moving the adoption of the report, detailed some of the results of the past three years' working. The gross revenue in 1886 brought in 27¼ per cent. upon the capital expenditure, the next year the receipts produced 27¾ per cent., and in 1888 28½, so that there was an improvement each year. On the other hand the working expenses had decreased during the last three years from 32 per cent. in 1886 to 26 per cent. in 1888; while looking at the net revenue it yielded a percentage upon the capital outlay of 5 per cent. in 1886, 7 per cent. in 1887, and 8 per cent. in 1888, the figures being £3,184, £6,007, and £9,059 respectively. The subscribers had nearly doubled, the number being 1,318 in 1886, and 2,610 in 1888, and the wire mileage very nearly threefold. There had been considerable increase in the business of the exchanges. Much of this satisfactory state of things had been largely due to the energy and ability of Mr. Lewis, the general manager.

Mr. Mark Whitwill seconded the motion, and mentioned that the company's business was growing fast, and was being developed as fast as it was expedient to do. The resolution was then adopted.

The Chairman then moved, and Mr. T. Pole seconded, the payment of the 6 per cent. dividend on the preference shares to the 31st December, and that the amounts already paid by the directors on account of such dividend be confirmed. This was adopted.

On the proposition of the Chairman, a dividend at the rate of ½ per cent. upon ordinary shares was agreed to.

Mr. Mark Whitwill was re-elected one of the directors. Commander D. M. Forsyth, the other retiring director, did not seek re-election on account of the long distance he resided from Bristol. Both the Chairman and Vice-Chairman expressed regret at Commander Forsyth's resignation, because of the great interest he had evinced in the company during the period he had been connected with it.

A resolution was next adopted authorising £200 to be placed to the special reserve fund, making a total of £1,200. The auditors —Messrs. Hudson Smith, Briggs & Co.—were re-elected, and another resolution was passed to give the auditors an additional ten guineas remuneration for the year 1888.

Mr. Inskip moved that the remuneration of the directors be increased from £400 to £500. The former sum was fixed when the company's net revenue was £6,000; but now it exceeds £9,000, he thought it was nothing but right that the directors' remuneration should be increased.

Mr. Reed seconded the motion, and it was adopted.

The Chairman returned thanks, and said he was glad several of the speakers had referred to Mr. Lewis, for his energy and zeal for the company's welfare was remarkable.

On the proposition of Mr. Reed, the meeting declared that the company should contribute twenty guineas to the Floods Relief Fund now being raised in Bristol.

Edmundsons', Limited.

THE statutory meeting of this company was held on its premises, 19, Great George Street, Westminster, on the 28th instant.

Mr. John R. Wigham, J.P., Chairman of the company, presided.

The Chairman congratulated the shareholders on the satisfactory position of the company. He stated that a larger amount of trade had been done since the acquisition of the business by the company, dating from July last, than in the whole of any year during which the trade had been carried on by their predecessors, and that the prospects of the company in view of the advances that are being made in electric lighting are exceedingly encouraging. He also mentioned that the shares had been all taken up within a few days after the issue of the prospectus, and that they are held exclusively by the customers of the company and the directors; many of the former being amongst the largest consumers of electric light in this country.

The outgoing directors were all re-elected.

Anglo-American Telegraph Company, Limited.—The directors have resolved to declare an interim dividend for the quarter ending 31st March, 1889, of 12s. 6d. per cent. on the ordinary stock and 25s. per cent. on the preferred stock, less income tax, payable on the 1st May to the stockholders registered on the books of the company on 1st April, 1889.

Telephone Company of Austria, Limited.—The directors have declared the usual half-yearly dividend to March 31st on their preference shares at the rate of 6 per cent. per annum.

Exchange Telegraph Company, Limited.—Lord Sackville Cecil has joined the board of this Company as chairman.

TRAFFIC RECEIPTS.

The Cuba Submarine Telegraph Company, Limited. The number of messages passing over the lines of this company during the month of March was [illegible], estimated to produce £4,500, against 4,919 messages, producing £3,835 in the corresponding month of last year. The traffic receipts for the month of December, estimated at £3,500, realised £3,508.

The West India and Panama Telegraph Company, Limited. The estimated receipts for the half-month ended the 31st March are £3,714, as compared with £3,714 in the corresponding period of 1888. The December receipts, estimated at £5,149, realised £5,229.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of March were £2,120, against £1,900 in the corresponding period of last year.

The West Coast of America Telegraph Company, Limited. The gross earnings of the month ending March 31st are £5,950.

THE TELEPHONE AND THE STATE IN FRANCE.

THE working of the telephone in Paris has at length attracted the notice of the authorities of that city. At a late sitting of the Municipal Council, M. Léon Dounat submitted the following proposition :—"The Council: Considering that the privilege of the General Telephone Company expires on September 8th, 1889, and that it is important to look ahead at the organisation of the telephone service in Paris and in the suburban communes; that complaints do not cease arising about the dearness and insufficiency of the present service; that, in fact, the present annual subscription is 600 f. at Paris, while at Glasgow it is only 375 f., 250 f. at Brussels and Antwerp, 200 f. at Gaud and Mons, 175 f. at Liège, 130 f. at Milan, 125 f. at Boston and Philadelphia, 120 f. at Genoa, 175 f. in the large towns, and 16 f. 80 c. on certain of the small lines of Sweden and Norway; that one counts 452 inhabitants per subscriber in Paris, while there are only 168 at Antwerp, 164 at Rome, 90 at New York, 55 at Chicago, &c.; that there is no cause for the City of Paris either to maintain the present privilege or to create another under analogous conditions; that if the working by the State, according to a contract similar to that of the City of Limoges, presents to the monopoly of a private company great advantages, it has the inconvenience of allowing the existence of the subscription price, like a tax, after the redemption of the capital engaged; that this working, even when it is as well conducted as in Germany and Switzerland, is more onerous than the direct working by those interested, as is proved in the case of several districts;

"Resolved: Article 1. The working of the telephone in the Department of the Seine shall be carried on by a co-operative society of the Paris and suburban subscribers. Every subscriber will engage, as now, to pay for three years the subscription price every half-year, and in advance. Article 2. The discount of these engagements will provide, in proportion to the needs, for the first establishment and for the expenses of working and keeping us. Article 3. The normal subscription price shall not exceed 400 f. per year for Paris and for the communications between Paris and the outskirts; it shall not exceed 200 f. for the suburban communes; exceptional subscriptions will be arranged for certain houses which make an extensive use of the telephone. Article 4. At the end of the period the net profits realised conformably to the statutes will be shared between the subscribers, and will thus come in deduction of the prices of subscription. These will be reduced themselves according to the progressive redemption of construction expenses. Article 5. Communication by telephonic cabins will be gratuitous for the subscribers, and reduced to 25 centimes (2½d.) for non-subscribers. Article 6. The co-operative society will be directed by administrators elected by the subscribers in general meeting."

Some interesting details on the State working of the telephone have just been given the *Journal du Havre*. At a sitting of the Havre Chamber of Commerce the President read a letter from the Mayor of Lille containing, in answer to a request from the Chamber, some particulars on the working of the telephones of that city since their purchase by the State. These particulars set forth that the Telephone Company, which formerly had the working of the lines, gave a more regular and careful service than did the State; that it introduced improvements in proportion to the discoveries of science, which was not the case now; that, in a word, the subscribers were much more satisfied, and that the substitution of the State for the company was not advantageous to them.

The telephone question has also just been before the French Chamber of Deputies. The concession granted in 1879 and renewed in 1884 to the General Telephone Company expires on September 8th, 1889. The State itself had constructed and worked telephone lines in the departments. Would it reserve to itself the working of all present and future lines? In 1886 M. Granet, Minister of Posts and Telegraphs, concluded with a company called the Société Fermière des Reseaux Téléphoniques de l'Etat a new convention, which he laid on the table of the Chamber, and which assured to that company the working of the telephones for a period of 35 years on conditions very disadvantageous to the State. This convention of M. Granet's has had no more luck than his convention relative to the Antilles Submarine Telegraph Cable. His successors, although numerous, have all refused to ratify it, and the present Government demands its rejection. The Committee appointed came to the same conclusion, and the Chamber declined to pass to the discussion of the articles.

POST OFFICE TELEGRAPHS.

(*From the "Times."*)

IN the House of Commons, on Thursday, March 28th, the House having gone into Committee of Supply, on the vote of the sum of £2,085,616 to defray the salaries and working expenses of the Post Office Telegraph service,

Sir G. CAMPBELL hoped that the Postmaster-General would be able to give the Committee some explanation with regard to the expense that would be incurred in taking over the Submarine Telegraph Company's system.

Mr. PICKERSGILL remarked that it was a misnomer to call this department a revenue department, inasmuch as it was carried on at a loss of some £850,000 a year, which was largely due to the very improvident bargain that had been entered into between the State and the railway companies, by which the latter were entitled to have their service messages conveyed free of charge. The railway companies, however, had availed themselves of this condition to send by telegraph communications that they ought to send by writing, and this course of proceeding resulted in a loss to the State of some £50,000 a year. He suggested that this right of the railway companies should be commuted by the payment of a lump sum. He was anxious that this subject should be fully discussed. He did not pretend to say whether the loss was justifiable or not, but he thought it ought to be fully discussed in the House. Were they justified in putting an annual burden of £200,000 a year on the country for the conveyance of Press messages? The profits went into the pockets of the proprietors of newspapers. They were no doubt a deserving class of the community, but they were only one class of capitalists. And he thought it was a serious question whether they were justified in conducting the service at a loss for the benefit of one class of capitalists while they were not prepared to do it for another class.

Mr. COCHRANE-BAILLIE said he thoroughly concurred in what had been said by the hon. member. The newspapers could well bear to pay a higher scale. Rumour told them that newspaper proprietors enjoyed very large incomes, and the country certainly should not be put to a loss on these Press messages.

Mr. JOHN ELLIS also entirely endorsed the remarks of the hon. member. The loss of £200,000 was serious, and it probably would increase. It was said that if they increased the charge many of these messages would never be sent, and would never appear. He was not at all sure if that would be a loss. And in particular he thought if the writers of tittle-tattle about members in London letters were restrained by increased charges it would be an advantage. The public got no corresponding advantage from this expenditure. There was another item to which attention should be directed, and that was the conveyance of messages for the railway companies. He thought the subject should be carefully inquired into, and some changes made. These were two of the principal items which gave rise to the deficit. They ought to consider the Telegraph Department as a commercial concern, and if they allowed these unproductive items to go on increasing they would be landed in a Serbonian bog.

Mr. SHAW-LEFEVRE expected that the Postmaster-General would have made some sort of financial statement dealing with the Post Office and Telegraph Services before the vote was taken. This had been the usual habit of the right hon. gentleman's predecessors. The last return dealing with the revenue account of the telegraph service showed an improved condition as compared with the previous one, and he should like to know whether the improvement continued, and whether in the year ending March this year the account would show a corresponding improvement as compared with last year. Hon. members had failed to notice the effect which the sixpenny telegram scheme had upon these finances. When that scheme was prepared he told the House of Commons that it was highly probable that there never would be in future any interest resulting from it. As to railway messages, he could not help thinking that in respect of these messages a very great abuse existed which ought to be remedied immediately. Railway messages had increased tenfold since 1871, and he had no doubt that the large proportion of those messages were not essential to the railway business of the companies, and that the wires were being used for other purposes. If a rigid examination was made he thought it probable that those messages might be reduced within reasonable limits. Perhaps the wisest course to adopt would be to buy up that interest of the railway companies. He thought it would be a beneficial arrangement for the Government; it would save labour and conduce to a probable gain to the revenue. In reference to Press messages he doubted whether the conclusions of the Committee were correct, and that the Press messages cost the country £200,000 a year. This statement had been made more than once. When he was at the Post Office he examined the matter and came to the conclusion that there was some doubt as to whether there was a loss to this amount. It should be borne in mind that those messages were for the most part sent at night, when the wires were not occupied. He thought in these circumstances that it would hardly be fair to charge the same rate for messages when the wires were unoccupied as for messages sent in the daytime. He should like to know what was the present position of the telegraph service and the prospects of the revenue from it.

Baron F. de Rothschild drew attention to the inconvenience and expense caused by telegrams sometimes uselessly sent to great distances from the village post office, which the receiver had to pay for instead of the sender.

Mr. Henniker Heaton asserted that instead of £200,000 a year being the estimated loss on Press messages, £50,000 a year would be ample to cover all loss occasioned by their despatch. The original estimated loss was greatly exaggerated, and the method by which it had been arrived at could not be relied upon. In his opinion the Telegraph Department was a model department, and the few reforms needed were being gradually introduced; but he could not say the same of the Post Office. If the accounts of the Telegraph Department were stated on commercial principles, the results would be shown to be much more satisfactory than now appeared. One of the great stumbling blocks in the way of preparing a commercial statement of the work of the Telegraph Department was the sum expended in the purchase of the telegraps. He had for a long time urged that it should be regarded as a Crimean war fund, and wiped away altogether. If that were done, and the accounts of the department were stated on commercial principles, the result would be found to be satisfactory.

Sir J. Swinburne urged that it would be a great convenience for every railway station in the United Kingdom to be a telegraph office also, as was the case on the North British Railway. Even if there was no staff of servants to send out messages at all stations, yet there was no reason why every station should not be a receiving office for the despatch of messages. When railway companies came for Parliamentary powers clauses might be inserted in their Bills compelling them to give the needful facilities for telegraphing from railway stations.

Mr. Sinclair contended that it would be a great advantage to many parts of the United Kingdom if the system of night or half-rate messages was instituted. It was a system which prevailed in the United States, and was there found very beneficial. In the case of towns like Belfast and Liverpool it would be a great boon, the mail leaving Belfast at 3 o'clock in the afternoon. Another question was the institution of a lower rate for messages after a certain number of words. For instance, 48 words cost 2s., and the charge for all words over 48 would be a farthing instead of a halfpenny per word. If that rule were adopted he believed a great many more messages would be sent.

Mr. Labouchere thought that it might be desirable to have night messages, but he did not see why they should be sent at half-rate. When the right hon. gentleman made his statement he hoped he would tell them something about the position of the telephones. It was eminently desirable that they should, as soon as possible, become an integral portion of the postal service. He would like to see a telephone at every post office, at which people could speak for two or three minutes at a low rate.

Mr. Munro-Ferguson hoped that the Post Office would not neglect the telephonic system. It would be most useful if the hon. member's suggestion as to having telephones at post offices were adopted.

Mr. Raikes said that the hon. member for Kirkcaldy had alluded to the subject of the salaries of the servants of the submarine telegraph companies whom it was proposed to transfer to the service of the Crown. The hon. member might rest assured that the Post Office in acquiring the undertaking of the Submarine Telegraph Company had not on this occasion fallen into the mistake made on a former one by recognising vested rights which were not compatible with the plainest and most obvious principles of justice. They had not taken over the whole of the staff of the Submarine Company, but had made certain exceptions. It had not yet been possible to ascertain exactly the amount of the cost to be imposed on the State by the addition of the work of the Submarine Company. Arrangements had been made to take over the great majority of the *employés* of the company upon these terms—they would, in the first instance, receive the same salary which they were now receiving from the Submarine Company. As opportunity served they would be drafted into the different classes of the postal telegraph service, when they would be invited to accept positions in those classes at the recognised rate payable in those classes. They would also be entitled to the prospect of annual increment and pension according to the scale that prevailed in those classes. In the event of any persons declining to avail themselves of these arangements they would be entitled to remain individually in the service of the Post Office, but at the salary they now receive, and they would lose all prospect of annual increment or of pension, and could only be allowed to retain the income they now enjoyed. He hoped they had acted justly towards these persons, but they had not been more liberal towards them than they were bound to be. With regard to the acquisition of the business of the Submarine Company, he was not yet in a position to say what sum was to be paid to the company for plant and goodwill. Though they were on the eve of arriving at a settlement, there was yet one nation, at all events, which desired further information before the ratifications of the convention were exchanged. He believed, however, that the committee and the country would be very well satisfied when they came to know the terms on which it was proposed to acquire the cable. Reference had been made by some hon. members to the painful but constantly recurring subject of the loss entailed on the country by the purchase of the telegraphs. He was able to refer to a very gratifying diminution of that loss in recent years. The deficit of 1887, upon which the Select Committee commented last year, amounted to nearly half a million, but the accounts for 1888 showed that the deficit was only £6,000 in that year. He was happy to say, in answer to the right hon. gentleman opposite, that the improvement in the postal telegraph revenue was still perceptible, and although the right hon. gentleman seemed to believe that there was no reasonable prospect of the postal telegraphs ever paying their way, he was happy to take a more sanguine view. He hoped that next year the small deficit of the previous year would be turned into a large sum on the other side of the account, and with the prospective profits from the submarine telegraphs now taken over, he trusted the profits would be very largely increased. He thought the figures of the last ten years would be of interest to the Committee. In 1879 the profit upon the working amounted to £280,000; in 1880 it was £296,000; in 1881, £325,000; so that that year the Service was within £1,000 of paying off the interest; the year following, 1882, the profit fell to £213,000; in 1883 it fell to £184,000; and in 1884 there was a deficit of £19,000; in 1885 there was a deficit of £36,000; in 1886, a deficit of £45,000; in 1887, a deficit of £145,000; and last year, 1888, a deficit of £6,000, which was the smallest deficit since they had got on the wrong side of the account. He ventured to believe that next year would see a substantial sum on the other side of the account. The deficit, which began in 1884, was coincident with the extension of the telegraph service and the increase of telegraph salaries. Although the sixpenny telegrams had been a very great obstacle for some time, he trusted that obstacle was now surmounted, and that they were now on their way to earn a profit. The deficit of £145,000 in 1887, although due in some degree to the sixpenny telegrams, was in a large degree due to extraordinary expenditure in that year, which would not occur in the following years. With regard to the loss on railway messages, he agreed that there had been a great departure from what must have been the original intention of Parliament. He did not think that Parliament could have contemplated that within 20 years the number of those messages would be multiplied tenfold. He should always be glad to extract a *quid pro quo* from the railway companies by enforcing upon them the necessity of giving greater facilities to the public, and he was quite aware that the private Bills coming before Parliament always afforded an opportunity of raising a question of that kind. As to how far the railway companies ought to be made to pay for the facilities given to them by Parliament, he would not like to say. With regard to Press messages, they were very well worthy of the consideration of the department and of the public. He must demur to the exact phrase of "loss of £200,000 on Press messages." He thought that was not the most correct way of referring to that part of the question. There was no doubt that if Press messages were sent at the ordinary rates charged to the public, the department would receive £200,000 a year more; but if the same rates were charged to the Press as to the public many of those messages might never be sent at all, and the department might not receive anything like £200,000 more than at present. That, no doubt, operated largely on the mind of Parliament and of the Ministers who were responsible for that part of the matter, as well as the question of the public convenience and benefit, quite apart from the personal profits of owners of newspapers which might result from cheap telegraphic rates to newspapers. The hon. member for Nottinghamshire made reference to both those questions, and he was extremely grateful to the hon. member for calling attention to the recommendation of the Committee that there should be a more strict adherence to commercial principles, and he would be extremely obliged to hon. members if they would assist him in carrying out that recommendation and aid him in resisting applications from those members who applied for every form of uncommercial arrangement for the benefit of the particular localities they represented. He thought it might be sometimes desirable, not so much in the interests of particular localities as in the interests of the general public, to carry out telegraphic works in connection with very distant parts of the Empire which were not strictly remunerative. For instance, in some places in the Highlands of Scotland telegrams are very few, and the offices not likely to be self-supporting, but it was absolutely essential to the living of the people that they should have ready means of telegraphing for salt to salt their fish, upon which the existence of some of the natives might be said to depend. He thought there were a few cases also where the same thing had been done in the North and West of Ireland. He was quite sure the Committee would not object to such expenditure, which was the exception from what he thought an excellent general rule. There was a point taken by the hon. member for Buckinghamshire with regard to porterage. Undoubtedly the rule was that the sender was responsible for those charges. If the sender was not aware of the exact porterage to be paid, and the office was not aware of it either, it was the duty of the latter to require a deposit, and that rule ought to be strictly enforced. It was quite possible that a sufficient deposit might not have been obtained, and in that case application might be made to the receiver; but he thought the whole expense ought to be upon the sender; and if the hon. member was aware of any cases of hardship and would submit them to him he would consider them. The hon. baronet the member for the Lichfield Division had urged the increase of the number of telegraph offices at railway stations. He found that there was a great objection on the part of railway companies to their servants acting as servants of the Post Office; and it was not desirable to force upon them duties which would interfere with their first duty. It would not, therefore, be easy to increase the number of telegraph stations in this direction. He was at the same time quite willing to consider any case for the establishment of a telegraph office at a railway station where public convenience would be served, and he should be glad to consent to any such proposal where it could be done without unnecessarily infringing on the revenue. The hon. member for Falkirk had brought forward the question of half rates for night messages. The present rate at which messages were transmitted was barely remunerative, and it would be more than doubtful whether the revenue would stand the strain of messages at half rates. He would remind the hon. gentleman that the American initial rates were very much higher than ours. Where the rate was 2d. or 2½d. a word it was possible to send at half rate, but he could not hold out any hope that such a suggestion would be accepted in this country, where the charge was only a halfpenny a word. The tendency of messages was to get shorter and not longer. The average amount per message was now distinctly below 8d. It was 7·9d. And as the tendency was in that direction, it was likely to be still further developed as time went on. Before the 6d. telegrams were introduced the average was 1s. 1d. per message. He did not think that the state of the revenue of the department would justify him in holding out any hope with regard to a cheaper rate of telegraphic transmission. As to the telephonic system, the Courts had declared it to be a part of the Government monopoly in telegraphs. His predecessor (Mr. Fawcett) unfortunately stated in public that steps would not be taken by the Government to enforce the rights which that judgment gave them, and a state of things had thereby been created which required very careful handling so far as the Department was concerned. The patents, however, were likely to lapse very soon, and when they had run out that would be the time to make arrangements, which he trusted would differ in almost every respect from existing arrangements. With regard to telephones being put into post offices, that was subsidiary to the larger question. In some parts of England the telephonic system was under the control of the Government absolutely, and there it was, of course, comparatively easy to make arrangements such as had been indicated. So long as the telephone companies continued to ply their trade, it was not desirable, he thought, that the Government should commit itself to arrangements which might seem in any way to recognise or establish a vested interest, which he for one could not admit existed. The grievance of the public in this matter ought, no doubt, to be removed as soon as possible, and it should be done upon terms satisfactory to all parties. He congratulated the Committee upon having taken a step which had been looked forward to for many years by all who were anxious to extend our telegraphic system—the step of sanctioning the acquisition of the system of the Submarine Telegraph Company, from which he anticipated the most beneficial results alike for the public and for the Department.

Sir J. **Pease** would like to remind the Postmaster-General that if the business of his Department had increased, the railway business had also very much increased. The Government Department was not the only department which had to face the increased requirements of the public; but the right hon. gentleman did not convey the idea that there was any friction between his Department and the railway companies.

Mr. **Cochrane-Baillie** expressed the hope that the Postmaster-General might see his way to providing that in the case of reply telegrams in rural districts the messenger should wait some short space of time for the reply. At present this depended entirely on the messenger's amiabilty, which in its turn depended on a pecuniary douceur. Having regard to the already prohibitive tariff in regard to telegrams for delivery in rural districts, he thought the Post Office might well make this concession.

Sir J. **Puleston** hoped that the Postmaster-General would give the Committee an assurance that he would soon be in a position to grant the public the boon of free addresses.

Mr. H. **Fowler** said the hon. gentlemen seemed to wish that persons should send telegrams gratis at the expense of the public. It was no part of the scheme of sixpenny telegrams that there should be free addresses, and he thought any such proposal would be retrogressive. Experience had shown how very much addresses could be shortened when they had to be paid for. He desired to express his great satisfaction at the figures so clearly stated by the Postmaster-General, which showed that while the interests of the public were not disregarded, the business was as a whole conducted on sound commercial principles and in an admirable manner. He did not agree with the right hon. gentleman in debiting the annual profits with the sum of £145,000 as he had done, for this in any ordinary commercial books would be set down as outlay for developing the business.

Mr. S. **Buxton** hoped that before the purchase of the Submarine Telegraph Company's telegraphs was completed some opportunity of discussing the proposed terms of sale would be afforded.

Mr. **Henniker Heaton** urged upon the Postmaster-General the fact that the cable companies did not pay enough for the special wires allotted to them.

Mr. **Halley Stewart** asked the Postmaster-General whether he could not obtain more definite figures as to the cost of Press messages, which he alleged to be despatched at a loss?

Mr. **De Lisle** thought the porterage rates in rural districts unduly high. In these districts the sixpenny telegram was practically non-existent. By far the greater number of town telegrams related to trade and manufactures, while those to and from rural districts would relate to agriculture, and it was to be hoped that the Post Office would soon be able to devise a scheme by which town and country might be placed on an equality with regard to telegraphic facilities.

Mr. **Molloy** said he had a very strong impression that an understanding was come to in the House of Commons that, as soon as 6d. telegrams were a financial success, the inclusion of addresses should be considered. The cheaper telegrams were made, the more would the telegraphs be used. It could easily be understood that a casual telegram to an official like the Postmaster-General would be lengthened by the inclusion of titles; but he believed that on the average five words covered addresses.

Sir R. **Lethbridge** said that a reasonable concession would be that four or five words for the address, or part of it, should be sent free of charge; and this would really amount to a reduction in the general cost of telegrams.

Mr. **Cossham** said that, while they had no right to expect that the department should be carried on at a loss, they might well insist that as soon as 6d. messages paid addresses should be wholly or partially included.

Mr. **Causton** said that before the telegraphs passed into the hands of the Government longer messages than at present could be sent for 6d. within the metropolis. He hoped that at no distant time the experiment would be tried of including addresses in the charge.

Sir J. **Puleston** said he should be willing to acquiesce in the restriction to five words of the allowance to be made for the address, and he believed there was an understanding, though not perhaps a bargain, that the inclusion of addresses should be considered as soon as a financial equilibrium was established.

Mr. **Shaw-Lefevre** said there was no understanding whatever come to at the time that 6d. telegrams were adopted as to a return to free addresses; and the difficulty chiefly put forward was not the financial one, but it was the large number of words used unnecessarily in addresses when addresses were free. It was found that the average number of words for the names and addresses of sender and sendee was 13, and the surplusage involved a large loss in transmission which was saved by abolishing free addresses. He believed that now the average number of words required for names and addresses had been reduced to four. This showed a saving both to the public and to the department. He believed the Postmaster-General would perform a very unwise task if he were to revert to the old system of free addresses.

Sir G. **Campbell** thought the country was to be congratulated on having acquired the Channel cables. He hoped there would be an early reduction in the rates for telegrams. He was in favour of there being a low rate for newspaper telegrams, provided that they were really interesting to the public, but care ought to be taken that public money was not expended on messages about pugilism, royalties, and subjects of that kind. As to telephones, there was a very convenient service in Switzerland, and he did not see why we should not possess similar advantages. With regard to the House itself, it was most inconvenient to go beyond the outer lobby in order to despatch a telegram. The journey was not only long, but also dangerous, because hon. members were liable to fall into the hands of strangers.

Mr. **Raikes** said the estimated cost of reverting to free addresses was no less than £400,000 a year, and he would be a bold Minister indeed who would hold out a prospect of incurring such a loss in restoring the old system. His hon. friend wished them to institute a roving commission to ascertain how the Transatlantic and other submarine cable companies transacted their business. He did not see how such an enquiry could be prosecuted, as we had no right to overhaul the books of those companies. Therefore, he could hold out no hope of such an inquiry being instituted. There was no intention on the part of the Government to acquire the telephones by purchase. He might, in conclusion, take this opportunity of referring to the grievous loss the Telegraph Department had just sustained in the death of Mr. Patey, who was a most competent public servant. His loss was deeply felt and his memory was endeared to all who had had the advantage of serving under him.

Mr. **Henniker-Heaton** wanted to know whether the Postmaster-General was satisfied with the amount which the cable companies paid to the Government for the use of the wires. That amount was, he maintained, very much less than it ought to be.

Mr. **Raikes** said that the Government made a fair profit under the present arrangement, and that was all the answer which he could give the hon. member. As to the amount of money which the people who used the wires made under the arrangement, that was a matter which lay wholly outside the consideration of the Government.

The vote was then agreed to.

The following correspondence has appeared in the *Times* since the debate above reported took place :—

Sir,—Referring to the Postmaster-General's speech in the House of Commons last evening, I think it only fair to this company to state that so far back as the 11th of March, 1885, we wrote to the Post Office, strongly urging on the Department the expediency of allowing the post offices within the London postal district to be used as public telephone call offices. I enclose a copy of our letter, which perhaps you may find space to print.

Our suggestion, had it been adopted by the authorities, would, we feel convinced, have tended greatly to the benefit of the public as well as to that of the Post Office.

I am, Sir, your obedient servant,
James Brand,
Chairman of the United Telephone Company, Limited.

Oxford Court, Cannon Street, London, E.C., *March 29th*.

"Oxford Court, Cannon Street, *March 11th*, 1885.

"Dear Sir,—The United Telephone Company, being very desirous to extend to the entire public of London the facilities afforded by their telephone exchange, beg for that purpose to make a proposal to the Post Office which they trust will be favourably considered.

"The company is ready to place one or more telephones in every post office within the London postal district for the use of the public, who by this means will be enabled to communicate instantly with any of the subscribers to the exchange, now numbering not far from 4,000 of the most important business firms and private persons in London, and daily increasing. My company would be willing to make special terms with the Post Office for such a service, and to make any reasonable arrangement that the department desires, including the right to the Post Office to take the entire revenue from the fees payable by the public for the use of the telephone.

"Probably, as the Post Office is about to introduce the system of sixpenny telegrams, the same charge of sixpence might—at least in the beginning—be fixed for a telephone talk of a certain number of minutes.

"My company is, however, quite willing that the Post Office should fix the rate, provided it be not too high, the object of my company being, as I have said, to afford to the entire public of the metropolis the utmost possible facilities for the use of the telephone.

"Hoping for an early and favourable reply,
"I am, dear Sir, yours faithfully,
"Thos. Blaikie, *Secretary*.

"C. H. B. Patey, Esq., General Post Office, E.C."

CONGRESS OF ELECTRICIANS AT THE PARIS EXHIBITION.

By a Ministerial decree dated July 16th last, it was decided to hold an International Congress of Electricians. All the arrangements are now completed, and the Congress will open on August 24th, and remain open eight days. Below we append the circular and programme relative to this Congress, which have been issued to those likely to be interested in its work:—

Circular.

The International Congress of Electricians, which met at Paris in 1881, marks an important date in the history of electricity. The consecration of practical unities has had on the development of science and industry an influence, the significance of which cannot be exaggerated. The extreme rapidity and facility with which the decisions of the Congress were accepted, in the study and in the laboratory, demonstrate their utility. The International Exhibition of 1889 offers a natural occasion of continuing and completing the work of 1881. Not that the new Congress may have to treat of problems of so general and elevated an order, but many questions still remain on which an understanding or, at least, an exchange of views is desirable. In the programme which it has prepared, the organising committee has not been pretentious enough to indicate them all, and still less to impose limits to the field of activity of the Congress. It has simply wished to call attention to those which appeared to it of more general and more immediate interest. We believe we respond to the unanimous feeling of electricians in placing the following questions foremost: Practical measure of electrical energy in all its forms; measure of the current in absolute value with standard of easy reproduction; electricity meters for continuous and alternating currents; practical evaluation of the lighting; definition of the constant quantities of a machine from a commercial point of view, &c. We hope that the *savants* and manufacturers who have contributed to the progress and application of electricity, and all persons interested in this new branch of human activity, will readily respond to our appeal, and contribute to give this meeting the importance and authority of that which preceded it.

Programme.—First Section.

Measures.—Units; recent works on the unit of resistance; reports on the unit of the electro-magnetic system and of the electro-static system; new practical units.

Measuring instruments of the different electrical sizes: current, resistance, electro-motive force, capacity, coefficient of induction, magnetic field, power, energy.

Practical standards of current and electro-motive force.

Second Section.

Induction Machines, Transformers, Distribution.—Recent progress in the theory and construction of generating and receiving machines; calculation of their elements; automatic regulating processes; definition and measure of yield; comparison of alternating current and continuous current machines.

Transformers, continuous current, alternating current; calculation of their elements; determination of yield; comparison of the two systems.

System of distribution; canalisation.

Central stations; advantages and inconveniences of the employment of machines of great power compared with that of an equivalent group of machines of reduced power; reserve machines; advantages and inconveniences of the electric and mechanical connections of machines.

Third Section.

Electro-Chemistry.—Piles and accumulators; types employed in industry; electro-motive force, sale, capacity, duration; net price of electric energy.

Electrolysis.—Electro-motive force necessary for the electrolysis of the usual compounds.

Electrotype.—Density of currents; composition of baths, temperatures employed; their influence on the quality of deposits; separation and affinage of metals.

Electro-metallurgy.—Electric furnaces.

Fourth Section.

Lighting.—Lighting of factories, houses, and public thoroughfares, necessary lighting in each case; its measure, distribution, and intensity of the sources to employ; comparison between voltaic arc and incandescent lamps, incandescent lamps of great intensity.

Regulators.—Means to be employed to diminish the resistance between the machines and the lamps.

Incandescent Lamps.—New processes of manufacture, their influence on yield and duration.

Mode of working of central stations.

Fifth Section.—I. Telegraphy.

Employment of machines in the production of currents, establishment, employment, and duration of subterranean lines, ærial lines, rapid transmission apparatus, multiple apparatus, lightning conductors.

II. Telephony.

Improvements in telephones and microphones, piles.

Establishment of lines, effects of induction, long distance telephony.

Organisation of central offices, commutators.

Subscribers' posts and public cabins. Employment of a single wire for several posts.

Service regulations, statistics and regulations.

III. Various Apllications.

Electric watches, chronographs, registers, signals, applications to war, the navy and public works, telluric currents.

Sixth Section.

Electro-Physiology.—Comparison of the effects obtained by the employment of the various medical apparatus; necessity of defining the currents which are used.

Nature of electrical phenomena which are produced in human beings; effects of discharges of continuous and alternating currents on animals; electrolysis of tissues; precautions to be taken in electric installations.

PROCEEDINGS OF SOCIETIES.

Institution of Electrical Engineers.

"On the Disturbances arising from the Use of 'Earth' for Electric Lighting Purposes."* By W. H. Preece, F.R.S., Past-President. The magnetic field produced by a current flowing in a straight wire, and returning through the earth, extends to such distances that it is quite impossible to say where or when or how a telephone circuit in that field would be disturbed by any changes in that current. It is quite certain that if a single conductor between Deptford and London were subject to rapid alternations under a potential difference of 10,000 volts—the current returning by way of the earth—every telephone circuit in the metropolis would be disturbed and probably rendered unworkable. The law determining the distance to which this influence extends was given by me in a paper read before the British Association at Manchester in 1887. It is given in the following equation:—

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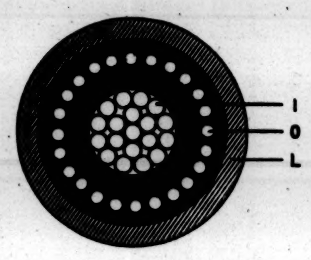
* Paper read on Thursday, 28th February, 1889.

$$c_2 = \frac{c_1\, l}{d^2\, r_2} \times M;$$

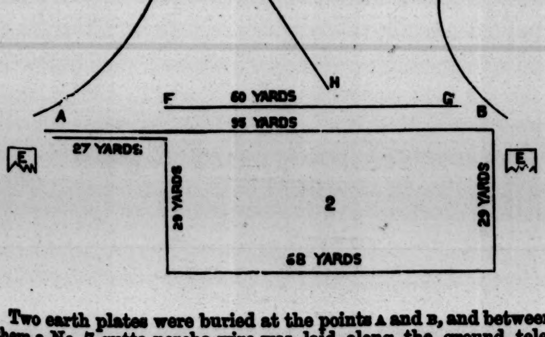
c_1 being the primary current, c_2 the secondary currents, l the length of the primary, d the distance between the wires, r_2 the resistance of the secondary, M a constant dependent on the frequency of the primary currents and the rate at which they rise and fall.

It follows from this formula that currents of rapid frequency on a conductor 10 miles in length, carrying 100 ampères, might be evident at a distance of 19 miles. It becomes, therefore, important to decide to what extent disturbing influences can be eliminated. It is well known that if either the disturbing circuit or that disturbed be constructed of two wires so close to each other and so erected that the mean average distance between the disturber and the disturbed is the same, no inductive effects are evident, for the influence on one wire is entirely neutralised by the equal and opposite effect on the other. But if this mean average distance is not equal, or if the equality of the two currents be departed from, then a disturbance will arise which will depend on the difference between the two currents and their relative distances. Hence the most perfectly silent telephone circuit becomes noisy when leaks occur in the insulation, and hence it is that the earth plays such an important part in the efficiency of the system.

It was reported in the technical papers that the London Electric Supply Corporation contemplated laying a concentric conductor between Deptford and London, with the external copper conductor in contact with the earth. As it seemed to the Post Office authorities very doubtful whether such an arrangement would be free from disturbance, experiments were made to test the point. The experiments were made by me in an open space of two or three acres in extent. A concentric cable was constructed so that the outside and enveloping conductor could be insulated or not. The inner conductor was composed of a strand of nineteen No. 15 B.W.G. (72 mils.) copper wires. The outer conductor completely surrounded the inner, and consisted of twenty-four No. 16 B.W.G. (65 mils.) copper wires. Each conductor weighed about 1,600 lbs. per mile, and gave a resistance of ·56 ohm. The outside sheath was of lead. The following is a full-size section of the cable:—



The following diagram will explain the arrangement of the wires:—



Two earth plates were buried at the points A and B, and between them a No. 7 gutta-percha wire was laid along the ground, telephones being inserted at each end. The electric light cable was laid between the same points by a circuitous route, as shown. At the points C and D two earth rods were driven in, and another No. 7 gutta-percha wire was laid outside the area enclosed by, and about a foot from, the cable.

Beyond each of the gutta-percha wires, extension wires were carried to enable metallic loops to be made up, forming approximate squares (1 and 2 on diagram).

Experiment No. 1.—A Wheatstone transmitter placed at B was connected to the inner conductor, I, of the cable, the lead sheath, L, being used as the return wire. Reversals at top speed (a frequency of 80 per second) were sent through the cable from an E.M.F. of 20 volts, the current strength being about 1·3 ampères. Loud disturbance was heard in the telephones at A and B when the transmitter was running.

Experiment No. 2.—Earth bars were driven in at the points, F and G, and connected by a wire and telephone. Currents were picked up by the telephone through this section, their effect being apparently quite as loud as between A and B.

Experiment No. 3.—The points, H and I, were similarly connected, and with a like result.

Experiment No. 4.—The points, C and D, were next connected by the wire attached to the earth bars, a telephone being inserted at D. Disturbances almost as loud as on the circuit, A, B, were heard.

Experiment No. 5.—The wire, C, D, was disconnected from the earth bars, and a metallic circuit forming an approximate square was made up (1 on diagram). The interference was still heard, but was only about half as loud as when the earth was used at C, D.

Experiment No. 6.—The insulated outer *conductor*, O, was substituted in place of the lead sheath as the return wire, and the disturbances in the loop, C, D, ceased entirely.

Experiment No. 7.—The outer conductor, O, and the lead sheath, L, were coupled together, forming jointly a return wire in contact with the earth. The disturbance in the metallic square, I, reappeared, but was reduced in loudness to about half that in the fourth experiment.

Experiment No. 8.—The cable was next laid out straight from A to B, the telephone wire being parallel to it. When the lead sheath was used as the return wire, loud disturbance was heard in the telephones at A and B. When the lead sheath and outer conductor were jointly used as the return wire, the noise in the telephones was greatly reduced (to about one-fourth).

Experiment No. 9.—To prove that the result obtained in the last experiment was due to earth conduction, a metallic square (2 in diagram) was formed, and the disturbance in the telephones disappeared.

It follows from these experiments that the disturbance of the potential of the earth at A and B, and the establishment between these two points of a potential difference cause currents to flow through the earth between A and B which destroy the equality between those in the inner and outer conductor of the concentric cable upon which equilibrum depends. It is therefore quite clear that the use of the external sheathing as part of the conductor in contact with the earth is quite out of the question; whereas if the enveloping conductor be insulated it is quite innocent of disturbance, and would not interfere with neighbouring telephones.

The question has arisen as to whether the currents experimented with (viz., those produced by a Wheatstone transmitter) are of the same character as those produced by an alternating current machine. The frequency in the two cases may be alike. Taking the frequency at 100, it will follow that each current, whether it be of the Wheatstone transmitter or of the alternating current machine, will rise from zero to maximum and fall from maximum to zero in ·0025 second. The strength of current generally used in the Wheatsone transmitter is 50 milliampères, while that of an alternating current machine may amount to 100 ampères; and since most of the Wheatstone circuits in this country are long circuits, upon which the resistance and the capacity are considerable, it is quite evident that in actual practice the rate at which the current rises and falls is greater in the case of alternating current machines than in the case of the Wheatstone transmitter. The fact that it is so is sufficiently proved in actual practice. Before the Grosvenor Gallery Company established their present metallic loop system, all the telephones around and about Bond Street were disturbed. In order, however, to settle the matter, I have carefully experimented with the currents produced by the alternate current machines at West Brompton and at Eastbourne, and I find that it is quite impossible to detect any difference between the effects of Wheatstone transmitters and alternating current dynamos.

These experiments, taken alone, are sufficiently definite to render it decisive that the use of the earth in such instances cannot be allowed; but it may happen that in other systems of distribution where the currents are continuous and steady, such as the systems by which it is proposed to distribute by means of batteries, the earth under exceptional circumstances may be permitted.

ABSTRACTS
OF PUBLISHED SPECIFICATIONS, 1888.

3072. "Improvements in automatic electric induction apparatus." H. W. **Rhoads** and F. W. **Tichhurst**. Dated February 29. 8d. The inventors employ a small magneto machine which is brought into action for a given time, by placing a coin voucher or its equivalent in a slot, and its falling between locking springs or their equivalents, and on drawing out a handle it winds up a spring or its equivalent, by a chain being drawn off the spring barrel on to a fuzee wheel, and on the coin or its equivalent being liberated, the spring rewinds the chain back on to the barrel and causes the armature to revolve, thereby causing a current to be felt at the handles of the machine. The strength of current is shown on a dial in front of the machine, which current is regulated and controlled by one of the handles of the machine acting on the magnet keeper by being pulled out or turned in either direction. The claims are 3 in number.

9254. "Controlling devices operated by means of the thermic effects of electric currents." B. M. Drake, J. M. Gorham, E. Manville and W. L. Madsen. Dated June 25. 8d. The inventors cause the whole, or part of the current, to pass through a composite strip made of two or more different metals having unequal rates of expansion under the influence of heat. As the current passing through the strips increases, the heat engendered, which causes the strips to bend, also increases. The movement thus obtained is utilised by suitable means to complete the circuit of an electric bell or other electrical alarm or it may be communicated to a switch, cutout, or other form of control suitably arranged to work.

10604. "Improvements in the elements for secondary batteries." I. A. Timmis. Dated July 21. 6d. Claim:—An element for secondary batteries consisting of a solid plate or cake of a compound of litharge and a suitable solution, preferably sulphate of ammonia, and enclosed by a framework of celluloid or other insulating material to prevent it buckling, the said element having a contact, preferably of lead, fastened against it by inoxidisable bolts and nuts or by any other suitable means.

14772. "A meter or apparatus for measuring continuous or alternating electric currents." G. F. Redfern. (A communication from abroad by L. Brillié, of Paris.) Dated October 13. 8d. Is based on the employment of the torsion electrodynamometer and serves to measure periodically the angle of torsion of the spring of the electro-dynamometer. The claims are 2 in number.

15388. "Improvements in apparatus for regulating dynamo-electric machines." A. Shippey. (A communication from A. G. Waterhouse, of America.) Dated October 25. 8d. Relates to improved mechanism adapted to regulate the current-producing capacity of dynamo-electric machines. The improved mechanism is applicable to dynamo machines of constant electromotive force, with a variable current such as used for incandescent lighting. The claims are 5 in number.

15612. "Improvements in insulators for electrical conductors." J. C. Love. Dated October 30. 8d. Consists of an improved means of insulating electrical line conductors, more particularly in underground conduits, and of securing the conductors therein. The invention is especially designed for mounting electrical conductors in conduits for electrical railways. The claims are 9 in number.

15865. "Improvements in multiple printing telegraph apparatus." C. J. Munier. Dated November 2. 1s. 1d. The object of this invention is to augment, in a considerable degree, the number of despatches that can be sent through one and the same line wire. In carrying out the invention, the inventor uses the "Hughes" telegraph instruments, with which the new apparatus is combined. The claims are 6 in number.

16099. "Improvements in the construction of electrical switches, cut-outs, ceiling, and wall connectors." C. M. Dorman and R. A. Smith. Dated November 7. 8d. Consists principally in enclosing the switch, fuse, connector, or other similar fitting in a light metallic box or case which is preferably stamped, pressed, or spun out of sheet metal. The base of this box is generally held to the wall, ceiling, or other surface to which the fitting is attached by screws which pass through the insulating base. A large central hole is usually pierced out of the flat bottom of the metallic base for convenience in leading in the wires. The lid of the case fits on to the base like that of an ordinary canister and in the case of switches, connectors, and similar fittings has a central hole through which the handle, connecting plug, or wire passes. In the case of ordinary ceiling connectors this hole is plugged with an insulator where the wires pass through. The claims are 4 in number.

16146. "Improvements relating to electro-medical batteries." F. Moreton. Dated November 7. 8d. Claims:—1. The building up or construction of a battery of a number of pairs of elements disposed in close juxtaposition with each other, and secured to a frame in the manner and for the purposes substantially as set forth and shown in the drawings. 2. In combination with the battery described and referred to in the preceding claim, the enclosing case containing two acid-proof troughs, substantially as and for the purposes set forth. 3. In the improved battery herein described, the mode of and means employed for separating and strengthening the elements, substantially as set forth. 4. The method adopted for connecting the various series of elements, substantially as set forth.

17008. "Improvements in dynamo machines." F. V. Schiödt. Dated November 22. 6d. Consists in that besides the usual shunt winding in the machine and instead of the winding which is traversed by the main current a second one is used which connects two points either in the positive or negative conductor in such a manner that this winding becomes a branch wire to the positive or negative side of the conductor system. The wire will therefore be traversed by a current the strength of which d upon the loss of tension between the two points which it co There is 1 claim.

17063. "A new or improved electric spray producing appar H. A. B. Huguet. Dated November 23. 6d. Claim:— spray producing apparatus the combination of a globe pr with openings in which are placed two tubes (terminati capillary tubes and containing wires for conducting elect and with openings, the one for receiving a ventilating tube the other a mouthpiece, the entire apparatus being fitted sliding support, substantially as described and represented drawing.

17688. "Improvements in and connected with electric railw S. H. Short. Dated December 4. 8d. The inventio absolutely independent in operation and construction of sectional single line conductors for the reason that it comp sectional double line conductors, and is impossible of constru and operation unless two conductors extend the entire lengt the railway, although either one or two conductors may be for the return circuit. If the railway extends from one pol the generator to the other pole, two conductors, and not less t two, must be employed throughout the circuit from one pole the other. The claims are 5 in number.

CORRESPONDENCE.

Series Electrical Traction System.

I have pleasure in giving you the information yo ask for in your issue of the 22nd.

You are under a misapprehension in supposing th the motor is ever short circuited. It is the field magne alone that are dealt with in all the manipulations of t motor, and this is the case when the motor is revers to stop the car.

The field magnets are short circuited, and their co nections reversed, and then opened again to the curre Of course no undue strain is put upon the motor b using it in this way, as the current is kept constant o the line, and at the most the motor can only exert th same pull to stop the car as it would otherwise be nor mally exerting to propel it. There is therefore n more than ordinary "sparking" at the commutato which, as far as one can judge, is wearing splendidly This method of braking the car is entirely successful.

As regards your other remarks as to the narrowin of the slot I may, I think, from information I obtained while in San Francisco, say that the only reason trouble was experienced there in that way was owing to the exceedingly light and rough construction of the firs cable lines put down there, and most of which on this account have been since reconstructed.

The conduit of the line at Northfleet is of exceedingly substantial construction, and is not likely to give any trouble in this way.

E. Manville, *Engineer.*

March 27th, 1889.

Underground Conductors.

The interesting paper on Underground Conductors, by Mr. Chenoweth, in your impression of the 22nd ult. should, I think, be carefully perused by the elec trical engineers of companies intending to start central stations.

Would not Mr. Chenoweth's experiences of the lead covering of the cable becoming decomposed by bein in close proximity to iron pipes be carried out in a exactly similar way in the "armoured" cables now coming into vogue in England? The lead tubing which covers the insulation proper is only separated from the steel "armour tape" by a thin layer of jute One would imagine that decomposition would tak place in the same way as Mr. Chenoweth says it does when a lead-covered cable is drawn into an iron pipe.

Perhaps some of your readers can tell us if such cables have been in use for any length of time.

R.

BOURNEMOUTH—We cannot recommend any boo of the kind you require. 5s.